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Book Reviews

Elements of Water Bacteriology, with Special Reference to Sanitary Water Analysis. By Samuel Cate Prescott, professor of industrial microbiology, Mass. Inst. of Technology, and C.-E. A. Winslow, professor of public health, Yale School of Medicine. Fifth Edition, Revised—208 pages. Published by John Wiley & Sons. Price $2.50.

Since the first edition of this book was published, in 1904, there has been a great development of new methods and procedures in the bacteriological examination of water. The fourth edition, in 1924, brought the treatise up to that date, but the authors believe that "the time has now come when the numerous methods, old and new, should be examined with the object of securing not only the greatest accuracy, but the most practicable simplicity consonant therewith." This edition retains the details of the older methods and introduces those of the newer ones "in the hope that a somewhat radical evaluation and simplification of laboratory processes may be found possible in the near future."

From its first appearance, this has been recognized as an authoritative work on the subject, especially suitable for the sanitary expert and those studying to become such, without cumbering the text with the voluminous matters which would be of value chiefly to those who are making an exhaustive study of this subject. For these latter, or for those who wish more complete information on the development of the science and art, the authors have furnished a list of references to the literature of the subject which occupies thirty pages. There is, however, abundant reference throughout the text to the opinions of the various authorities and the works done by investigators in developing procedure. The subject matter includes the quantitative bacteriological examination of water and its interpretation, significance of the colon group in water and methods of isolating them, bacteriology of sewage, and bacteriological examination of shellfish.

Sewage Disposal for Rural Dwellings.—20 illustrations, 24 pages. Issued jointly by the Division of Sanitary Engineering, Department of Health, State of Ohio, and The Agricultural Extension Service of the College of Agriculture, Ohio State University.

This is an excellent and practical booklet, replete with many good illustrations showing how to install a septic tank and secondary treatment for rural dwellings. Disposal of the effluent is considered by the two most practical means—the leaching well, which works satisfactorily in porous soil, where the ground water level is low, and the subsurface filter.

The treatment throughout is very conservative, possibly too much so. For instance, metal septic tanks are not mentioned, though a great many places have found them to be far more economical and satisfactory than concrete tanks. If labor skilled enough to do a first class job is employed, the cost of the concrete tank is going to be large; if unskilled labor is used, the tank is going to be a botch.

It is suggested that the forms be supported on blocks while pouring, as shown in Fig 10. Under these conditions forms frequently shift. A better plan is to spike them to stakes driven firmly into the ground. Then a little extra concrete on one side will cause no trouble.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

Reports on Highway Matters by the A. R. B. A.

(*Continued from the January issue*)

Bituminous Subgrade Treatment in Minnesota

The Minnesota Department of Highways finds that bituminous treatment has no appreciable effect in preventing frost boils, according to F. C. Long, engineer of tests and inspection; and only those subgrades are selected for oiling which are not subject to frost boils. The state now has bituminous subgrade treatment on about 250 miles of the primary system and quite a mileage of the secondary.

On new construction the oil is placed directly on the subgrade, which is about 30 to 32 ft. wide between shoulders and should be smooth and have little crown at the time the oil is applied. An idea of the nature of the subgrade in that area may be obtained from the following analysis:

Passing No. 10 sieve	99.5%
Total sand	8.6%
Total silt	21.8%
Total clay	69.6%

A typical analysis of the oil most generally used is as follows:

Specific gravity	1.044
Flash	164° C
Specific viscosity at 60° C	12.9
100 penetration residue	65.2
Ductility of residue	100+
Loss at 163° C	2.8
Total bitumen (soluble in CS_2)	99.91
Total bitumen insoluble in 86° Naphtha	16.23

The subgrade, when treated, should be well compacted, smooth, free from dust and dry. Warm weather aids the penetration of the oil into the subgrade.

Gravel is placed in windrows on the shoulder line. Then the first application of oil, heated to about 180° F., is sprayed on one-half of the road at the rate of 1/3 to ½ gal. per square yard—as much as the subgrade will absorb in a few hours. After the oil has soaked in, usually about one day, the traffic (which has meantime been using the other half of the road) is turned onto the oiled section and the second half oiled. Then a second application of oil is spread on the first half at about ¼ to 1/3 gal. per square yard and immediately covered with gravel; and the second half is then similarly treated. The cover material, of which about 400 cu. yds. is used per mile, is about the composition of that used for gravel surfacing.

This treatment gives an oiled surface about ¾ in. thick, which is not sufficient to carry extremely heavy traffic, or ordinary traffic if the soil beneath is plastic.

Where this treatment is used, the roads are generally raised with the surface 4 to 5 feet above the bottom of the ditches, which are made quite wide, the grading running 16,000 to 22,000 cu. yds. per mile of 30 ft. to 32 ft. road. These roads when oiled remain in good condition after rains, while on untreated roads even light traffic creates an extremely bad condition.

This particular soil is a clay with high cohesion. The ground water level is well below the surface of the road, and by excluding surface water we have a close-grained soil in a condition to offer maximum resistance to the entrance and flow of capillary water. Under such conditions we do not have frost heaves or subsequent frost boils, and the road goes through the winter and the spring break-up in very good condition. The bituminous material used does not form a

Worcester, Mass., Changes

to Dorrco Bar Screens

When the sewage treatment plant was built at Worcester, Mass., some years ago, two plain screens were installed to catch the coarse solids in the flow. At that time no other method of coarse screening had been perfected. For years men labored, raking the solids from the bars by hand—an arduous and disagreeable task.

Now, on the identical locations of the old bar screens, two Dorrcos do the raking job mechanically. The Bars are always clean, screenings removals are greater, and backing up of sewage in the channels has been eliminated.

DORRCO BAR SCREENS
DORR DETRITORS
DORRCO SCREEN UNITS
DORR CLARIFIERS
DORR DIGESTERS
DORRCO SLUDGE PUMPS

DORRCO

Dorrco Bar Screens will do the work of raking in any type of sewage plant—new or old. They can be fitted with an automatic control which regulates the operation of the raking mechanism so that it works only as required. When the amount of coarse solids in the sewage is small and there is no accumulation on the bars, the screen does not operate. During storms or when the solids load is heavy, the screen works regularly and keeps the bars clean.

We manufacture three different types of screen, to suit varying conditions. Our nearest office will furnish full information.

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WILKES-BARRE, PA. Miners Bank Building
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hard mat and can be cut with blades, especially during hot weather, and considerable blading is used in the maintenance. In patching, we use a mixture of the road oil and cover gravel.

The initial cost of this type of treatment is about $1,400 to $1,600 per mile. On a typical section of Trunk Highway No. 6, 25 miles was first treated in 1926 by the method just described, at a cost of $1,448 per mile. In 1927, the road was treated using more bituminous material and more cover, at a cost of $1,262 per mile. The maintenance for 1928, with no retreatment, was $615 per mile. Maintenance for 1929, with no retreatment, will probably be about the same as for 1928. The traffic during period of August 5 to 11, 1929, was 703 vehicles per day.

Cost Records for City Streets

How University City, Mo., found its costs on street work, is told by Walter A. Heimbuecher, city engineer of that city.

When I started in University City, some sixteen years ago, I had about $5,000 a year with which to maintain the streets. This past year I had $50,000, and the coming year I will have about $65,000. The allotment is on a gradually ascending scale.

During the first three or four years, irate tax-payers called up and were coming into the office by the dozens about the holes in the streets. "You haven't been on my street this year; haven't spent a cent on it." I did not know—and could not contradict them. But after the work grew to a point that justified a street superintendent, we devised a system of reports which the foremen turned into the office daily, giving the amount of labor, the hours each piece of equipment was used on each particular street on which they were working, every pound of material, gallons of asphalt, tar, oil, cinders, or anything else. These items were posted on a special ledger sheet for each street.

My foremen's daily report sheets show the labor, foreman's time, amount and different kinds of material, the hours use of each type of equipment. We also have a fixed charge for overhead; during the first two years we were working out our maintenance costs, we didn't know how to charge the use of our equipment, so we kept a fairly accurate cost of what our trucks and rollers were costing and have been using those figures since.

These items we grouped in two or three or four blocks, just as we happened to work that particular street, and in about two years our efforts began to bear fruit. A tax-payer would come in and complain of maintenance neglect. I would reach under the counter in the front office and bring out the ledger and say, "Well, Mr. Man, I am very sorry that I have to disagree with you, but in May we spent $100 there, and in June we put down about 1,000 gallons of road oil, and in September we put on another 1,000 gallons of oil. In November we spread three carloads of cinders." The result is that from about three complaints a day in the fall of the year, when the rainy season is on, it has simmered down to about one a week, and all I have to do is reach for the ledger. It has been well worth the effort put into it.

Also now I know exactly what it has cost me to maintain every street I have, and I have about every type of street. I use these maintenance costs as a guide in planning my street improvements; when I find that a street is costing too much money to maintain, I promptly recommend to the board of aldermen

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that it is time to improve it, and we proceed to put through an improvement resolution.

Of course, cost of street maintenance as a basis of comparison doesn't mean anything. Take two streets of the same identical type; one may cost three times as much as the other to maintain because it carries traffic that wears out a pavement; so before your maintenance cost means anything at all, you must get a traffic count and find out what is going over it. The width of the pavement is another factor in the problem.

Perfect Accident Score for a Cement Plant

The Pittsburgh plant of the Universal Atlas Cement Co. (a subsidiary of the U. S. Steel Corporation), employing more than 500 men, operated without a single lost-time accident from September 3, 1929, to December 31, 1930, or 484 days. E. D. Barry, assistant operating manager, says that, although temperatures in the kilns reach almost 3000°, and heavy grinding and pulverizing machines abound with potential danger for the worker, mechanical safeguards and safety education have been so effective that "there has not been a serious machinery accident in recent years."

The plant received the 1930 annual safety trophy offered by the Portland Cement Association.

Our Roads and the Rest of the World

The United States contains 38 percent of the roads of the entire world, and spends for highway construction 63 percent more than all the rest of the world combined.

The figures forming the basis of this statement are published in the January 5 issue of "Commerce Reports," which is issued by the U. S. Department of Commerce. Those for expenditures may be somewhat inaccurate, since they were based on the budgets for 1930; or, where these were not available, on the expenditures in 1929. The latter being the figure used for the United States, however, it seems probable that the correct figures would be even more favorable; especially as it is believed that not all of the money budgeted by the other countries was expended.

Grouping total highway expenditures (other than those by the United States) by continents, we find Europe leading with 559 million dollars, then the rest of the Americas with 173 million; Asia with 148½ million, Australia and Oceania with 85 million, and Africa with 24½ million.

In mileage, the United States exceeds all of Europe by more than 20 percent.

Officials Should Explain Advantages Fully Before Calling for Vote on Bond Issues

At a recent special election, the taxpayers of a village on Lake George, New York, defeated a proposition to bond the village for $200,000 for the installation of sewers and a sewage treatment plant. This unfortunate action may have been due to the fact that the voters did not understand that in order that the cost of the proposed sewerage system might place no large burden upon the taxpayers, the board of trustees had worked out a system of retiring the bonds on a sliding scale of payments. In fact, the yearly outlay probably would not have been much greater than the present expense of maintaining and cleaning cesspools and private disposal plants, and the excess cost would be greatly exceeded by the resulting benefit to public health.

PUBLIC WORKS

An Engineering and Construction Journal

City County State

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That Prize Contest

Numbers of excellent suggestions of names for our water works digest have been forwarded to the *Bookworm* down south along the Mississippi, where he has been playing the part, rather, of our *Earthworm*, plowing through mud that seems an inseparable feature of levee building. More returns are still coming in, and we must postpone for a month the announcement of the winner.

On the Levees

New ideas in dirt moving have appeared in the past year, and more dirt is being moved more cheaply than ever before. After we have scraped off as much as possible of that Kentucky and Missouri mud (Arkansas, Tennessee and Mississippi have been fairly dry—from the weather point of view) and looked into the duck and goose possibilities of some of the Mississippi river sand bars, there will be articles in PUBLIC WORKS covering the more important methods and equipment used.

Meantime we want to present our compliments to the engineers, both army and civilian, engaged on flood control, for the efficient way they are handling this work.

They Both Look Alike—in Print

Our clipping bureau cuts out for the editorial department all items they see dealing with streets, highways, water, sewers, etc., but does not, of course, have time to read them—that is our duty, and sometimes pleasure. We got quite a "kick" out of this one which reached us the other day:

"SEWERS HOLD MEETING

"The second meeting of the A-1 Sewers club met last evening at the home of Miss Laura Bighinatti in Kensington. After the business meeting, refreshments were served. The next meeting will be held Thursday evening at the home of Miss Mary Grasse."

What Is the Engineer's Name?

This problem deals with three railroad employees—Smith, Jones and Robinson; and three railroad officials—Mr. Smith, Mr. Jones and Mr. Robinson.

1—Mr. Robinson and the fireman live in New York.

2—The conductor lives in Philadelphia.

3—Mr. Jones lives equidistant from New York and Philadelphia.

4—The locomotive engineer lives half way between Mr. Jones and the conductor.

5—The engineer's salary is exactly one-third that of the man living nearest to him.

6—The salary of the conductor's namesake is $10,000.

7—The employee Smith usually beats the fireman at billiards.

What is the engineer's name?

J. T. MORRIS, *President*
W. A. HARDENBERGH, *Vice-Pres. & Asso. Editor*
CROXTON MORRIS, *Ass't Manager*

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Aeration as an Auxiliary to Trickling Filter Treatment*

How an institutional plant, by means of prior mechanical aeration, was able to reduce the area of sprinkling filter required.

By G. M. Ridenour
Research Engineer, Department of Sewage Research, New Jersey Agricultural Experiment Station

AN interesting feature included in an institutional sewage plant recently completed at Annandale, New Jersey, is the use of partial aeration by mechanical means to allow the use of a reduced trickling filter area for the treatment of settled sewage effluent.

Description of the Plant

The complete treatment process consists of passing the sewage through a duplicate-compartment screen chamber, a circular upward-flow primary settling tank, two circular separate sludge digestion tanks equipped with Downes floating covers, glass-covered sludge drying beds, mechanical aeration tank preceding trickling filters, chlorination, and secondary settling. All units were designed at normal rates for full plant capacity with the exception of the trickling filter bed. This area was reduced in view of the preceding partial aeration treatment of the settled sewage.

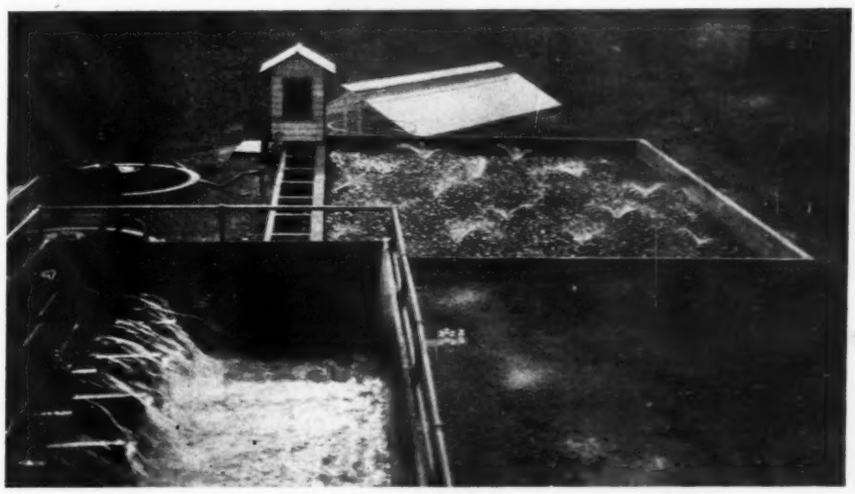


Fig. 1—General view of sewage treatment plant at Annandale Does not show screen chamber or primary settling tank

The completeness of the treatment and purification equipment provided in this case was considered desirable because of the very small size of the receiving stream, which runs through an open, populated section of the country. This stream is characteristic of the majority of streams receiving institutional wastes in New Jersey.

Sewage Flow

Figure 2, a typical sewage flow chart for the institution, shows the rapid fluctuations in the rate of sewage flow during the day and the difficult designing problem presented in providing for nominal rates in the various plant units.

The average daily flow is approximately 100 gallons per capita. However, during certain periods of the day the rate of flow reaches a maximum of 700 gallons per capita, while at night during a period of eight hours the rate of flow decreases to only seventeen gallons per capita, which is largely infiltration. Ninety per cent of the entire sewage flow occurs within a sixteen-hour period.

The first major peak shown on the chart is caused by preparations for the evening meal, before which shower baths are required. The following high peak is the result of after dinner operations in the kitchen. Similar high and low peaks on the chart indicate the habits of the institution.

This flow chart is characteristic of the flow from smaller institutions. As the institution increases in size, the fluctuations are smoothed out and the trend approaches that of municipal flows.

*Journal Series paper New Jersey Agricultural Experiment Station, Dept. Sewage Research.

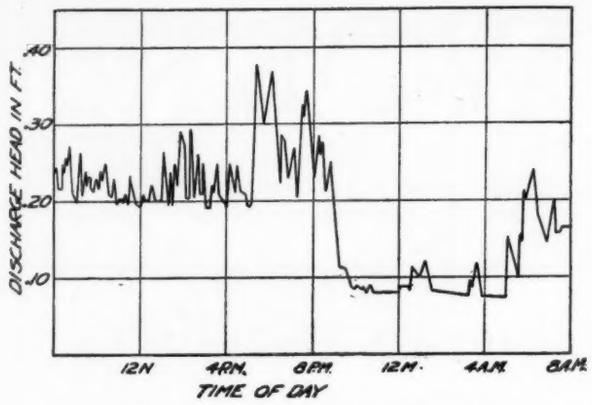
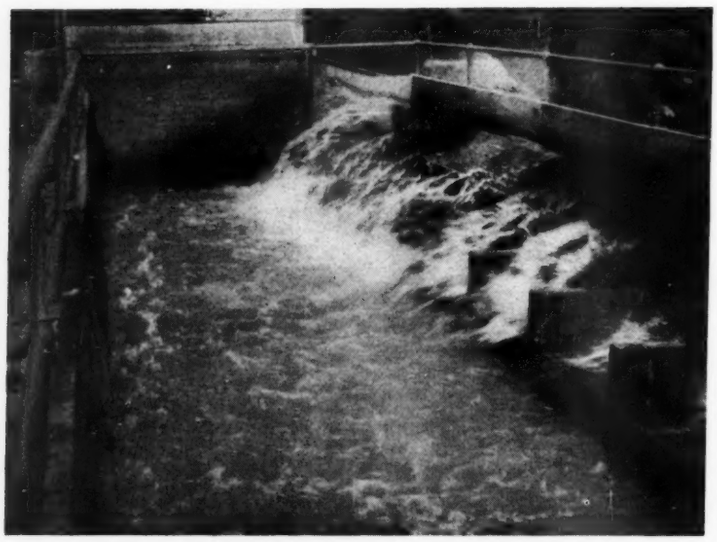


Fig. 2—Typical sewage flow chart

Description of the Aeration Tank

The aeration tank is shown in cross-section in figure 3. Circulation and aeration are effected simultaneously by means of a series of motor-driven wooden paddles spaced at intervals around the periphery of one common shaft. The paddle wheels in motion and surface view of the aeration are shown above.



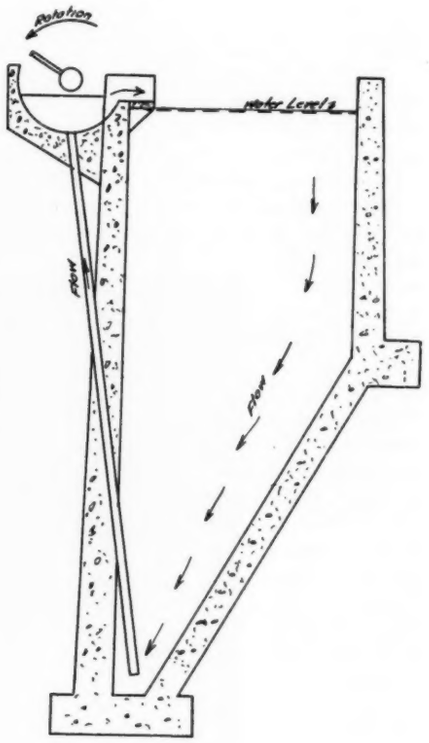


Fig. 3—View of paddle wheels in motion and surface view of aeration tank. At right, cross-sectional sketch of aeration tank

Aeration of the sewage results from the displacement of a small quantity of liquid from the trough which is thrown across the surface of the tank. In addition to the aeration of the sewage as it passes through the air, a surface rippling effect occurs which can be observed in the photograph.

Circulation of the sewage is caused by the same displacement of sewage from the trough which is replaced by the upward flow in the pipe running to the bottom of the tank.

At the present time the displacement occurs only once per trough per revolution of the shaft, since only one paddle blade is attached in each section. By the addition of three more paddles to each section, four times the present amount of aeration and circulation can be obtained. In addition to this, the speed of the paddle shaft can be varied fifty per cent either way so that considerable flexibility is available in the unit.

The tank is designed for a theoretical retention period of 3.5 hours at full plant capacity.

The purpose of aeration in this case is to serve as an aid to the subsequent filtering process by (1) partially oxidizing the soluble organic material in the applied sewage and (2) promoting flocculation of colloidal material. This should result in allowing the use of a reduced trickling filter area for final purification.

The aerator was designed and installed to furnish simple aeration only and was not intended to perform the functions of an activated sludge process. The mechanical difference lies in a much shorter aeration period and lack of activated sludge return facilities. The aerated sewage is not settled before application on the trickling filter. The action of the aerator differs biochemically in that the activated sludge floc activities are not present.

The process offers the advantages of less required area for plant location and cheaper initial construction cost, both of which approach the advantages of activated sludge without the disadvantage in institutional cases of requiring highly skilled operating attention.

Aerator Operation—The aerator is operated only 16 hours during the day. This is made possible by the regular habits of the institutional population, which contributes 90 per cent of the sewage flow during that period. It is deemed unnecessary to continue the aerator in operation during the remaining period for the small amount of night flow. During this period the increased bio-chemical demand on the filter will be counterbalanced by the greatly reduced rate of

(Continued on page 50)

Dane County's Eight Years' Experience With Low-Cost Road Methods

Dane County's original mixed-in place gravel road

By Geo. E. Martin

Consulting Engineer, General Tarvia Dept., The Barrett Co.

DANE county, Wisconsin, whose county seat is the city of Madison, the state capital, has been a consistent user of low-cost gravel road methods for many years. The county has continued to build gravel roads and to maintain the heavier traveled ones by surface treatments; building concrete pavements where it was considered that the traffic was too heavy for a gravel road.

The pioneer work in the tar surface treatment of Wisconsin gravel roads was done in Dane county in 1922. Only one mile was treated that first year, but the program has steadily increased from that time.

During the 1923 season the Wisconsin "turnover" method was invented, developed, and perfected in Dane county. This was one of the very early, if not the first, mixed-in-place methods, and substantially the same method is used for original treatments in Dane county today.

Excellent gravel was readily available in the county. The gravel surfacing consisted of material with a maximum size of one and one-quarter inches and did not contain more than twenty-five percent of sand when placed on the road. The over-size gravel in the pit was screened out, crushed and added to the surfacing gravel. The roads are from twenty to twenty-two feet wide.

The first operation in treating the gravel was to level the loose material with a blade grader so that it was uniformly distributed over the road surface. The loose material was from one to two inches deep.

This loose material on one side of the road was then treated with about one-third gallon per square yard of medium "Tarvia-B," which has a specific viscosity at 40°C of 13 to 18. The tar was warmed to about 140°F. in the tank car for application.

The tar-treated gravel was then moved into a windrow in the center of the road with a blade grader, thus exposing the consolidated gravel underneath. This in turn was treated with one-third gallon per square yard of the same grade of tar and the treated gravel in the windrow moved back over it.

These operations were then repeated for the other side of the road.

The tar-gravel mix was then bladed lightly to correct any uneven spots in the surface and to produce an even mix.

The road was left open to traffic during the entire operation and no roller was used, the tar gravel mix being consolidated under traffic.

No seal coat or cover material was used on the turnover work this year.

The following equipment was used:—1 Caterpillar tractor. 1 Fordson tractor. 1 Five-ton grader with 12-foot blade. 2 Barrett Tarvia distributors.

The average cost of the turn-over gravel surface treatment work was $1200 per mile of road averaging about twenty-one feet wide.

A total of fifty-eight miles of new gravel surface treatment work was done during the season of 1930.

In addition to the new mileage, 19 miles of gravel previously treated were sealed with "Tarvia-A." The remainder of the tar-treated gravel mileage did not need a surface treatment this year. The "Tarvia-A," which has a float test at 32°C of from 120 to 180 seconds, was heated in the tank car to about 200°F. and applied to the clean road surface at the rate of about one-fifth gallon per square yard. This was immediately covered with about 60 yards of pea gravel per mile, or approximately fifteen pounds per square yard.

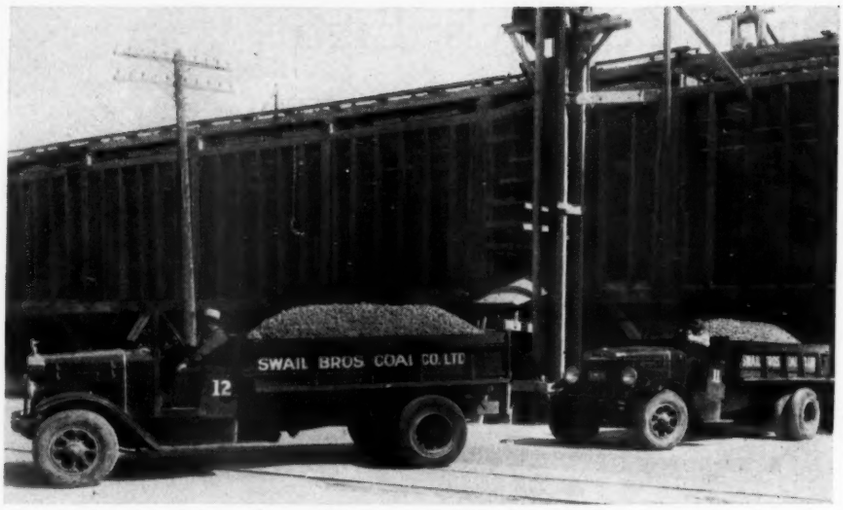
The surface-treated gravel roads are re-treated every second or third year in this manner at a cost of about $500 per mile for each treatment.

In this way Dane county is conserving its supply of good road building gravel and giving its citizens efficient road service at a low cost.

The members of the Dane County Highway Committee are J. R. Lyle, E. C. Sweet, and C. Lein. The surface treating work was done by Frank Roberts, assistant county highway commissioner, under the direction of J. R. Caldwell, Dane County highway commissioner.

Turnover gravel road near Belleville, Wis. Above—Mixing after first application of T. B. Below—Road two days after completion

Ready-Mixed Concrete Delivered by Contract for City of Winnipeg



Two International 2½ ton trucks (170-inch wheel base) obtaining materials from the Winnipeg overhead bins.

WINNIPEG, Manitoba, with about 200,000 population, at the end of 1929 had a mileage of improved streets as follows: Macadam, 30.7 miles; cedar block, 22.7 miles; asphalt, 155.7 miles; concrete, 32.4 miles; graded and graveled, 320.5 miles.

Its program for 1930 included 5 miles of asphalt and 9 miles of concrete. The city had, at Ross avenue, a plant covering a city block where all concrete for street surfacing was mixed. Here thirty-two 100-yard overhead bins are available for storing dry material, which is delivered to them by railroad cars moving over a track supported above them. A motor truck can be backed under any bin for receiving a load of any material desired.

At the Ross avenue plant there are also a 1½-yard concrete mixer, eight rubber-belt conveyors, screens for separating pit-run gravel, rock crusher, etc., all of which are electrically operated. The concrete mixer is operated by a 25 h.p. motor, and the crusher, which has a capacity of from 50 to 60 yards per hour, by a 100 h.p. motor. Crushed rock is obtained from the city's Stoney Mountain plant, where three crushers are operated and from 40 to 60 men employed. Gravel is obtained from Bird's Hill pit, 10 miles out.

A separate asphalt plant has been constructed in Water street. This plant can deliver sufficient binder and surface material to lay 1,200 feet of pavement 24 feet wide in an 8-hour day.

For transporting the ready-mixed concrete, asphalt and all other materials utilized in building and maintaining the streets, the city has contracted, during the past two seasons, with Swail Brothers, Limited, large coal dealers, who used for the purpose trucks which were busy delivering coal in winter but would have little of this to do in summer. The firm used as many as thirty-five trucks at times in carrying out the city contract.

The transportation of ready mixed concrete is quite a job in itself, the concrete mixer being able to deliver a 1½-yard load of concrete every two minutes, so that, when the mixer is steadily working, one truck must back in as another is pulling out with its load. The longest haul for the ready-mixed concrete is four miles. A maximum for one day from the Ross avenue plant has been 315 loads of concrete and 450 yards of dry material.

The asphalt, of course, is hauled hot from the Water street plant to its destination; dump trucks with tarpaulin covers being used for the purpose. The average mileage of a round trip for a single load is eight miles, and each truck travels from 80 to 100 miles in a 10-hour day.

All motor trucks in the Swail Brothers fleet are of the speed-truck type, equipped with 2-yard bodies with side boards and hydraulic hoists; most of them of International Harvester manufacture. Careful check is made, both by a city representative and by means of drivers' reports, of all materials hauled. The city representative makes out a ticket in triplicate for each load, one of which goes to the city's head office, an-

(Continued on page 54)

Delivering a load of concrete to a pavement job.

Salvaging Municipal Refuse in Three Cities

Methods employed and financial results from several years of operation in Washington, Rochester and Los Angeles.

WASHINGTON, D. C., let a contract for collecting and disposing of its refuse for a period of three years beginning July 1, 1918; but by November 4, 1919, several successive holders of the contract had found it unprofitable and the municipal government had to take it over and operate until June 30, 1921. It then rented the salvaging plant which had been in use, and used it until June 28, 1930, when the plant was seriously damaged by fire—fortunately, perhaps, for it was entirely inadequate in capacity. The plant was repaired and reopened Sept. 15th, 1930.

During the nine years of operation by the government it paid a rental for the plant of $9,640 in 1922, increasing to $11,500 in 1924-1927, and $10,300 for the last three years; also spending $27,935 for additional ground and equipment in 1923, and $5,945 in 1926 and $4,001 in 1928 for new equipment. Meantime the amount of refuse salvaged increased from 196,763 cubic yards to 259,447 per year. The weight of the salvaged material, however, has varied from a maximum of 20,613,238 pounds in 1922 to a minimum of 16,507,352 in 1928, being 19,501,509 in 1930.

During the nine years the revenue from salvaged materials has varied from a maximum of $129,266 in 1923 to a minimum of $52,611 in 1930; while the costs of disposal (not including collection) varied from $135,724 in 1930 to $97,373 in 1927. There was a net profit for only two years—$10,181 in 1923 and $6,306 in 1924. The net loss during the other years ranged from $9,077 in 1925 to $83,113 in 1930.

In 1930 the net loss was $2.84 a ton, including overhead on all expenditures for land and equipment. That year there were sold the following salvaged materials: 12,316,760 pounds of baled paper for $20,663; 4,525,111 pounds of baled tin cans, etc., for $4,127; 539,790 pounds of baled rags for $9,803; 1,241,744 bottles for $10,243; 1,263,166 pounds of broken glass for $3,579; 40,530 pounds of metal for $2,092; 48,650 pounds of rubber for $309; 146,630 pounds of books and magazines for $1,043; and sundries for $751.

The above figures are from a paper by Thomas L. Costigan, superintendent of street cleaning of Washington, D. C., before the International Association of Public Works Officials, who concluded by saying: "The above is not intended to be an argument for or against salvaging; it is simply a statement of the experience of the City Refuse Department of the District of Columbia in handling this phase of their daily task."

At Los Angeles, Calif.

At the same meeting the same subject was discussed by J. J. Jessup, city engineer of Los Angeles, Calif. He first presented the advantages of separate collection of wastes, in addition to its facilitating salvage work. Garbage should be collected more frequently than ashes or rubbish, and in water-tight tanks or wagons; also, it is heavy, requiring only moderate bulk to make a load. Dry rubbish and ashes do not require frequent collection. Ashes are heavy; rubbish is bulky and does not require tight wagon bodies. Therefore collecting all three classes together so as to meet sanitary, financial and physical requirements is difficult.

Garbage is salvaged by feeding to pigs and by reduction. Los Angeles in 1914 contracted for the disposal of its garbage by reduction, the promoters agreeing to pay the city 51 cents a ton for garbage delivered at the plant under a ten-year contract. The grease was used in soap manufacture and the tankage for chicken feed and fertilizer, and the company prospered until the price of grease fell after the war, and the company then threw up its contract. The city now sells it, loaded on gondola cars, to a company, which uses it for hog feed and the waste and hog pen cleanings for manufacturing fertilizer used on adjacent citrus groves. The company pays the city 60 cents a ton f. o. b. cars, and $1.20 a ton for transporting it to the hog farm 60 miles out of town, where it raises 50,000 hogs. These are fed an average of 19 pounds per head per day, and gain 40 to 80 pounds per ton of garbage, varying with time of year, quality of garbage and condition of animals.

All of the 43 other cities in Los Angeles County have for five or more years been disposing of their garbage by hog feeding, which is licensed and supervised by the County Live Stock Department, which enforces regulations to insure proper sanitation and management of the hogs, because of former trouble from nuisances and hog diseases. Ratproofing of feeding floors and water troughs is required, which not only protects the health of animals but permits supporting 15% more hogs with the same amount of feed. County veterinarians inspect the ranches regularly, enforce vaccination and give advice. The pork from garbage-fed hogs is excellent. The fat of peanut or acorn-fed hogs is soft; but if such hogs up to 80 pounds weight are changed to garbage, the fat will turn hard, comparable to that of grain-fed hogs.

The cash revenue to a city from salvaging its noncombustible domestic rubbish will be very small, but the saving in shorter haul to the salvaging plant than to the dump may be very substantial.

At Rochester, N. Y.

The operation of the salvage plant of Rochester, N. Y., was described by John V. Lewis, director of maintenance and operation, Department of Public Works. This plant, constructed in 1911, represents a capital cost to date of about $140,000. It is housed in a substantial brick, steel and concrete building about 200 x 55 feet in plan. The ground floor is divided into three sections—storage bins, a press room, and a boiler and incinerator room two stories high. The rest of the second floor is divided into a weighing and unloading room, and a pickling and sorting

room. There are two Decarie incinerator units, each capable of burning 50 tons of dry, combustible rubbish in 24 hours; also two 220 hp. Keeler water tube waste heat boilers, four forced and induced draft fans driven by steam, boiler feed pumps, etc. Steam generated by this plant is used to operate a Cobwell garbage reduction plant of 200 tons per day capacity, located adjacent to the salvage plant. All the steam is measured and the rubbish plant is given credit for it at the regular commercial rate.

This plant in the second year of its operation (1913) handled 8,660 tons of rubbish, from which approximately 22 percent of salable rubbish was recovered; the salvaging being thorough because apparently a good market existed for the salvaged materials. The total cost of operation that year was $23,360, and the revenue was $13,215, which more than offset the cost of salvage.

But since then the wages and cost of maintenance have increased and the revenues decreasd. During the ten-year period 1920-1929, the tonnage handled at the plant increased from 7,000 tons to 21,800 tons per year, or more than 200 per cent. The amount expended for salaries and labor in 1920 was $35,200 as compared with $53,800 in 1929, or an increase of about 50 per cent. It should be borne in mind, however, that during the first ten or more years of operation the plant as a whole utilized but a small part of its rated capacity, with one 8-hour working shift and at times one incinerator only in service. Because of this fact, the labor cost for 1920 was approximately $5.00 per ton handled whereas in 1929 the same cost had dropped to $2.50 per ton with a 16-hour period of operation in each day and two incinerators in use. Today the plant is grossly overloaded and the city will soon be required to provide an adequate addition.

The working force now consists of a chief engineer and a clerk, who supervise the operation; 10 engineers and stokers; 1 handy man; 3 paper balers; 13 pickers and sorters; and 13 dump men and rakers. The rate of pay varies from 75 cents per hour for engineers to 37½ cents per hour for pickers in the sorting room. The average rate figures about 50 cents per hour with an expenditure of 5 man-hours per ton handled.

To return to the question of revenues obtained from the sale of salvaged materials, in 1920 the gross amount received was $13,415. No credit was given for steam produced. For the year of 1929, the revenues amounted to $17,675, a decrease on a comparable tonnage basis between the two years mentioned of more than 135 per cent. In fact, the actual cost figures for the year of 1929 show that there was a deficit between revenues and the expense of picking, sorting, and baling of salable materials of $570. This figure does not include any portion of the labor cost for the 13 dump men and rakers who constitute about 28 per cent of the total labor cost for the plant. With a system of straight incineration, a considerable portion of the latter expense would be obviated because the refuse would be conveyed direct to the furnaces by means of travelling cranes and grab buckets.

It is true that during 1929 the rubbish plant produced more than 38 million pounds of steam for use in the adjacent garbage reduction plant and thereby obtained an extra credit of almost $21,000. However, it is a happy and fortunate coincidence that the latter plant exists and provides an outlet for steam which would otherwise bring only a small return. The amount of steam generated at the present time represents only about 25 per cent of the total amount required for operation of the reduction plant near by. With the conditions which are peculiar to the existing layout of the refuse disposal plants at Rochester, it is believed that it would be more economical to incinerate *all* combustible rubbish and utilize the heat produced for steam generation. Without a doubt the future extension of the rubbish disposal plant will mean the abandonment of salvage operation and substitution of straight incineration. With the widespread recommendation today for incineration of all refuse, there is an interesting sidelight in the cost of disposal of garbage and rubbish at Rochester. During the year of 1929, the "Cobwell" reduction plant handled more than 34,000 tons of garbage at net cost of approximately $1.00 per ton. In the same period, the rubbish plant salvaged and incinerated about 22,000 tons of rubbish at a net cost of more than $2.00 per ton. The combined cost of refuse disposal amounted to $1.50 per ton for the total quantity or 56,500 tons handled. These figures are operating costs and do not include interest and depreciation charges.

Paving Backfilled Trenches in Detroit

BACKFILLING of trenches opened in the streets of Detroit and repaving of same must be done under the supervision of inspectors when not done by the men of the Dept. of Public Works, who do trench repaving over such cuts as are not made by the public utilities; the utilities, however, make nearly all the cuts.

Backfilling is required to be tamped in 3-inch layers, the use of frozen dirt or soft mud being forbidden, and other dirt being procured when that excavated is not satisfactory. On this is placed the removed concrete and asphalt, broken into pieces not over 2 inches diameter, and left one-half to three-quarter inch above the pavement, until the permanent repair is made. The concrete used for repair must conform to the specified mix and consistency and be tamped into place.

Whenever possible, the concrete is replaced within 24 hours. During the rush season this is not always possible, but every effort is put forth to replace the pavement promptly.

Core tests are taken at irregular intervals from the paving patches. When this was started in 1928, several patches were found which were unsatisfactory in the character of backfilling and quality of concrete. In several cases there was a space between the concrete and top of the backfill. The attention of the supervising inspectors and the public utility superintendents was called to the results of the tests, and decided improvement was found in the work by the later core tests. The 1929 tests show that the concrete averages well over 2,500 lbs. at 28 days.

Tunneling a Highway Under Newcastle, Calif.

A TUNNEL 531 feet long is being driven under a portion of Newcastle, Placer county, California, also passing under the main line of the Southern Pacific Railroad.

Newcastle is located between Roseville and Auburn on State Route 17 and Government Route 40; which road, aside from its local importance, is a portion of one of the main transcontinental highways. Situated on a high knoll as it is, its tortuous narrow streets lend themselves to almost anything else than boulevard construction, the necessary widening and straightening for which would have practically wiped out the small city.

As the Southern Pacific Railroad must be crossed at this point, and is of such height as to allow the construction of an underpass, all other tentative locations, after careful weighing of such factors as cost, alignment, grade, and public convenience and safety, were abandoned in favor of the more direct route through the hill under the town and the railroad.

A few of the salient features of a comparison between the present traveled way and the new location are indicated by the following comparison of the present highway and the highway under construction:

	Highway under construction	Present highway	Difference favoring new route
Length	6182 ft.	7600 ft.	1418 ft.
Total rise	145 ft.	219 ft.	74 ft.
Adverse grade	None	74 ft.	74 ft.
Minimum radius curve	1500 ft.	50 ft.	....
Maximum grade ...	5.12%	*8.00%	....
Minimum width roadway	46 ft.—30' in tunnel	21 ft.	....
Total central angles in curvatures	71°	670°	599°

*2200 feet of present grade is 7.80% or greater.

In addition to the problems stated, the new location involved many local problems which necessitated a great deal of care and planning. The present water and sewer system of the town must be entirely changed and several houses moved; two county roads and the main ditch of the Pacific Gas and Electric Company had to be relocated so as to pass on the railroad sides of the tunnel portals.

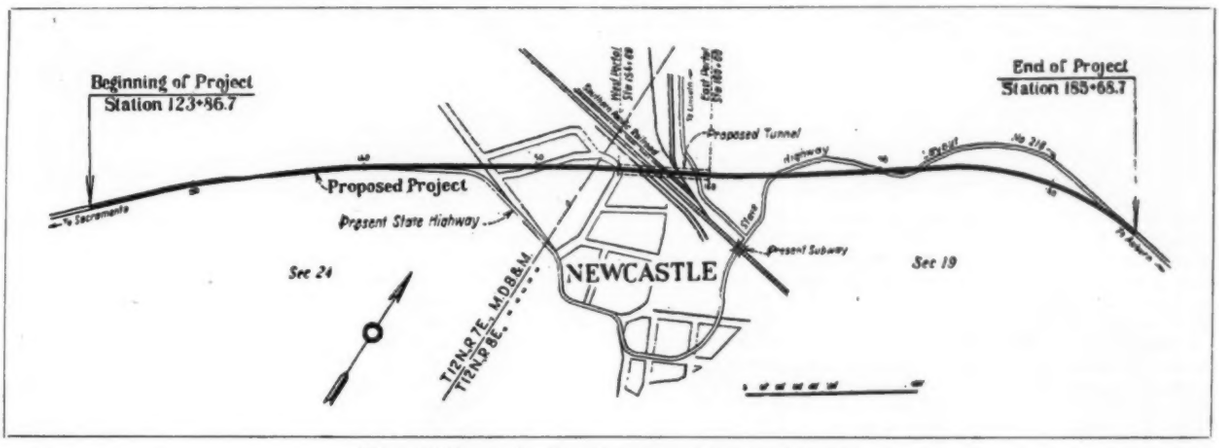
Sketch of tunnel under Newcastle

Preliminary borings were taken and the elevation of the grade of the tunnel established so that its entire length is in solid granite. This established the elevation of the grade of the tunnel under the Southern Pacific tracks at a depth of approximately 86 feet below the base of rail.

The roadway of the new section is normally 46 feet in width, narrowing to a paved 30 feet through the tunnel and heavy approach cuts with a three-foot sidewalk on either side. The center line clearance of the tunnel is 20 feet 9 inches.

Three types of lining will be used, the sections at the two ends and the section immediately under the

(Continued on page 54)



Map of Newcastle, showing route of proposed project

Chemical Sewage Treatment Forty-three Years Ago

WHAT is believed to be the first plant constructed in the United States for the chemical treatment of sewage was completed in East Orange, N. J., in 1888. We recently ran across a description of it, with illustrations, in the "Scientific American" for Nov. 17, 1888; and it seems worth while to reproduce the article for both its interest to sanitarians and its historic value.

This plant did much to impress upon engineers, and especially the citizens at large, the fact that there was more to the sewage disposal problem than just running a sewer to a river. This was a most ambitious move by the citizens of East Orange, and an important milestone in the development of sewage disposal in this country.

The township of East Orange may be accepted as a representative surburban community. It is to a great extent inhabited by those who are in business in New York. It is rapidly increasing in population, and the problem of sewage disposal, as well as of water supply, has assumed, of late years, considerable importance. It is situated near the opening of the Orange Valley, a region where drainage offers peculiar difficulties owing to its remoteness from tide water. Improved water works have recently been constructed, and as the need for drainage was thereby increased, an improved system of sewerage was introduced.

In August, 1886, the plans for the sewerage system were practically completed. They had been designed by Mr. Carrol Ph. Bassett, who had just made a special study of the subject in Europe, with whom was associated the eminent sanitary engineer Mr. Rudolph Hering. The works comprise a pipe system and disposal works. Contractors originally undertook the work, but abandoned it, and it was completed by the city, with Mr. Bassett acting as manager and engineer. The disposal station, which is the most original and interesting portion of the works, was designed entirely by him and was constructed under his supervision.

The lines of the sewer are laid in vitrified pipe, forming a complete pipe system. . . .

The sewage collected by the pipe system is conveyed to the disposal works, illustrated on the first page. They comprise a dual system of sewage disposal by chemical treatment combined with intermittent soil filtration. Works are established on a low piece of ground, along one of whose margins is a brook which ultimately runs into the Passaic River. The sewage is received at the side of the main building. Within the main building are tanks, in which the chemicals are prepared. These are essentially milk of lime and sulphate of aluminum. Mixing with the sewage, the familiar reaction takes place between them, by which alumina is precipitated, carrying down with it all solid matter. The two mixtures are delivered to the stream of sewage as it comes to the works. It then runs through a square brick main to the tanks. This main is about 100 feet long, and is broken up continually by partitions running part way across, so as to resemble a fish ladder, by which name it is colloquially known. The object of the partitions is to break up the stream of sewage and mix the chemicals thoroughly with it. After running through this conduit it enters the tanks. Of these there are two, divided by low walls into separate compartments. The sewage is first received in two small square compartments, which are in free communication with the main tanks, except that a wooden sliding gate is provided between each of them and the main tanks, which floats upward as the water rises, so as to keep back the surface water, whereby bottle corks and all floating matters are kept within this division, to be removed from time to time. Under the gate the liquid flows, beginning at once to precipitate, and as it reaches the large tanks, where the current is, of course, slower, it precipitates still more. Two low walls run across each tank.

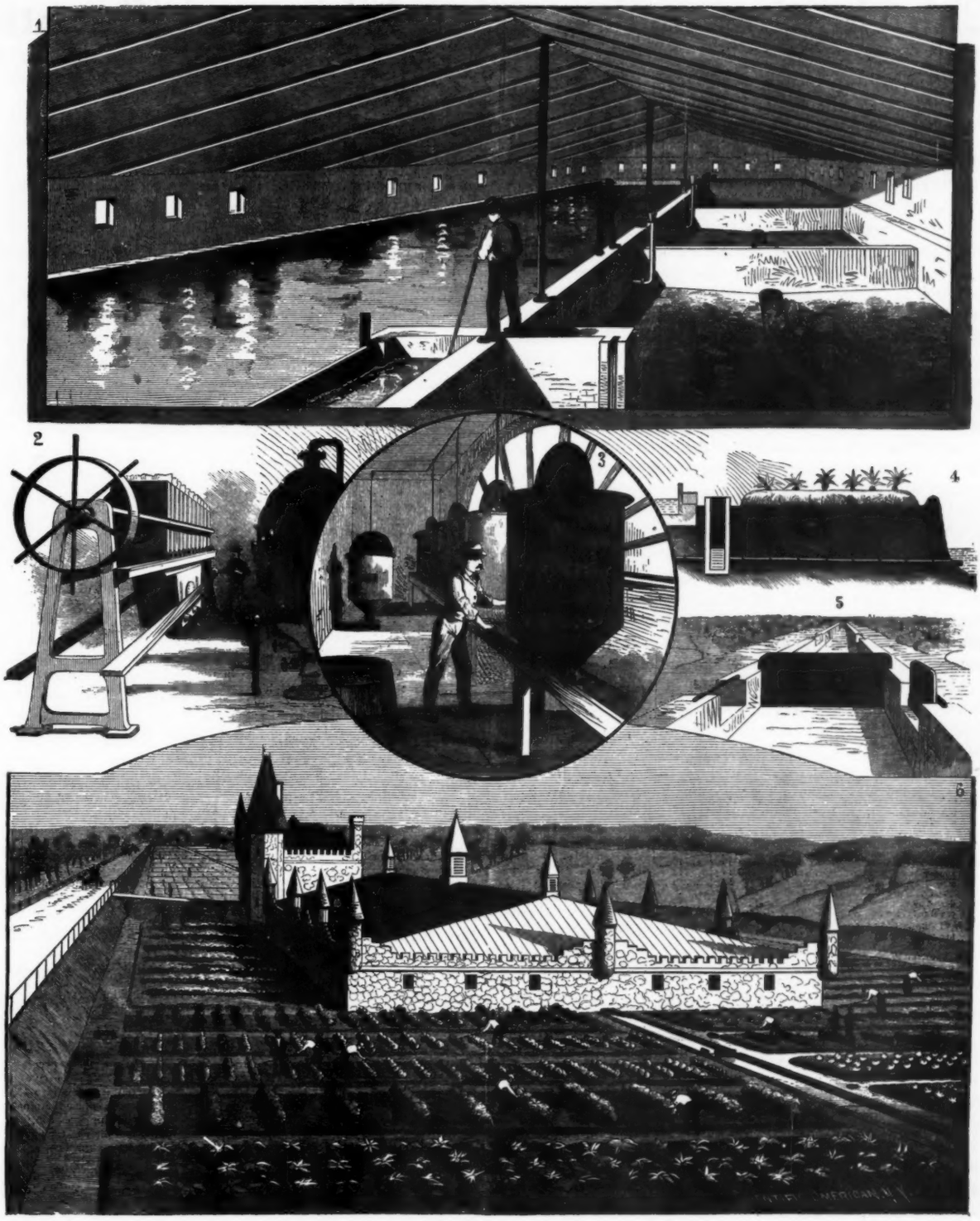
The sewage runs over the tops of these, from compartment to compartment, so that a progressive precipitation of the solid matter takes place in the three divisions. When it reaches the third it is perfectly clear, and thence it is allowed to run out to the filtration beds. Through the entire length of the three tanks and under the cross walls an open drain is carried, called the sludge channel, in which the precipitate settles. The semi-liquid mass is pumped thence into vacuum pans in order to avoid any contact between it and the pumps, and when the pans are full, the mass is forced by pneumatic pressure into multiple filter presses of the standard type, now extensively used in chemical works. Here it is filtered through canvas, the clear water passes out, and the chemically precipitated matter remains behind and is collected as cakes of a general disk shape and quite hard. As yet no analyses have been made of this material to determine its value from the agricultural point of view. It is proposed to sell or use it as it accumulates, for a fertilizer. Its value will undoubtedly be quite high, though the small quantity collected will preclude any large aggregate return from its sale. The liquid matter from the presses is run off with the rest to the irrigation farm.

Still one more operation is to be provided for, and this is the independent emptying of the tanks, which has to be done from the surface in order to avoid carrying off the solid matter. A low-level main is therefore carried to each of the first divisions. At the bottom of the tanks it is provided with a valve. At the point of its entry into the bottom a pipe is connected to it by a joint, so that it can be swung up or down. At the top the swinging pipe is provided with a filtering arrangement to secure the exclusion of the coarser particles of matter, and floats are attached near its mouth, so that it is always kept at the surface level of the water in the tank, wherever that level may be. When it is desired to empty the tank the valve at the bottom is opened, the water immediately runs out through the opening of the floating pipe, which sinks with it, and through the conduit connected therewith to the filter beds.

From the end of the tank house a long rectangular open conduit is carried within a few feet of the surface of the ground. It is provided with sliding gates, which can be entirely removed or put in place to check the flow of the water, and it communicates with lateral canals, also provided with similar gates. By means of these the stream of water can be turned over any space desired. The entire farm is, moreover, provided with subsoil drains laid five feet below the surface and communicating with the brook before alluded to. The area, which includes many acres, is cultivated, and grass and various vegetables are grown thereon. Irrigating trenches are run at right angles to the open conduit. The general operation consists of diverting the outflowing stream of clarified, purified sewage to different areas where it may be required. The rest of the operation is entirely automatic; the almost odorless liquid spreads over the ground, is absorbed to a great extent by the vegetation, and any which soaks through is received by the subsoil drains and delivered to the brook perfectly clear. The area irrigated under this new system is considerable, and is to be gradually extended and developed until it is converted into a model farm or vegetable garden. It is anticipated that the richness of the soil will render the return from the crops very lucrative, and it is expected that the revenue from this source will go far toward paying the running expenses of the works. Of course at present this is in an experimental state, and no figures can yet be given which would have any bearing in determining the value of the experiment as regards this feature.

The works have now been running some five months, and of course have not yet been subjected to the trials of winter. Should any difficulty arise in disposing by filtration of the liquid matter, on account of frost, it will be treated more thoroughly with chemicals, so as to be perfectly clear and inoffensive, and then will be delivered directly to the brook.

As stated in the article, chemical treatment was brought from England. In a book on sewage treatment published in England in 1888 there are listed 454 patents for chemical treatment of sewage, the earliest of which was granted in 1846, for "precipitat-



1—Settling tanks. 2—Pressing room, filter press and vacuum tanks. 3—Chemical room. 4—Drainage of irrigation bed. 5—Gate in irrigating conduit. 6—General view of sewage building and farm.

East Orange Chemical Sewage Treatment Plant Forty-two Years Ago

ing with slaked lime and bringing the sewage gases evolved in contact with chlorine or hydrochloric acid gas." One, patented in 1868 and used in several plants, was called the "ABC process" because it used a mixture of alum, blood and clay and seven other substances. Fifty-four British patents were granted in 1886. Several of these use lime, alum, manganese, or one or more of scores of other materials. Many endeavored to recover ammonia from the sewage.

Among the interesting ideas found in this book written forty-three years ago, is a suggestion of aeration. "Where a very high degree of purification is aimed at, the water, as it passes away from the last tank, may be aerated."

Chlorination of Sewage and Sewage Effluents

Description in concise form of the uses to which chlorine is put by sewage plant operators, the results obtained, and the cost. Slightly condensed from a paper before the American Society of Municipal Engineers by George B. Gascoigne

CHLORINATION of sewage was, it is believed, first practiced sporadically in Germany, England and the United States during the twenty years prior to 1900. But the first intelligent study of it by modern methods in this country was begun in 1906 by Prof. Phelps. Since then, stimulated by the Chlorine Institute, supplemented by independent investigators, the science and technique have made notable progress and this use of chlorine is increasing. Recent investigations and use have demonstrated the inadequacy of early data, and also the usefulness of chlorine in connection with sewage treatment.

At first bleaching powder, and later liquid chlorine, were used to disinfect settling tank effluent, being applied at fixed rates with long contact periods. Later, W. D. Tiedman, of the New York State Dept. of Health, and L. H. Enslow, of the Chlorine Institute, established that maintenance of a slight excess of residual chlorine in treated sewage is necessary for securing a high degree of disinfection; also, that the chlorine requirements of sewage vary with seasonal changes, and that adjusting the dosage to daily or hourly requirements effects economy.

The first experiments, it is believed, to determine the effect of suspended solids upon the efficiency of disinfection were made in Cleveland under the direction of Harrison P. Eddy, from which it was concluded that:

(a) Present-day sampling procedure for raw sewage does not give a true index of actual conditions, in that many bacteria, say 40 per cent, elude detection.
(b) Disinfection is of relatively little value unless subject to very careful control according to the quantity and quality of the sewage.
(c) Disinfection will be more efficient if the suspended matter is removed beforehand. Therefore, the degree of efficiency indicated by the usual method of analysis is then approached.
(d) The removal of the coarser suspended matter does not aid disinfection to the same extent as the removal of the same quantity of fine matter, because the latter contains the greater number of organisms.

Based largely on these conclusions, the two Cleveland treatment plants were designed, one to chlorinate Imhoff tank effluent, and the other a sewage passed through gratings with ¾-inch openings, both to protect bathing beaches.

The degree of suspended solids penetration by chlorination has been further studied by Tiedman for ineffectively settled sewage; by Scott and Pool for fine screened sewage, and by Sandquist and Foote for crude sewage first passed through a macerating impeller. In each case a residual chlorine content from 0.3 to 0.5 p.p.m., after a contact period of 10 minutes, apparently proved sufficient to insure satisfactory disinfection. Without residual chlorine the suspended particles were ineffectively penetrated, if at all.

Prechlorination

It has been indicated that chlorinating the influent of a settling tank rather than its effluent is generally preferable for several reasons, not the least being the more uniform and dependable action. Another is that less chlorine may be required; also it can often be applied in the sewer above the plant. Experience indicates that solids from even a heavily chlorinated sewage, when mixed with digested sludge, will be digested as readily as unchlorinated solids. Also, with prechlorination there is less initial decrease of the pH value of mixtures of solids and sludge in digestion tanks. The flow chambers of settling tanks appear to keep in a fresher condition, solids do not tend to belch to the surface and odor is thereby diminished.

The Newer Uses of Chlorine

Controlling Odors at Sewage Works is perhaps the outstanding development. More than fifty plants in this country are using chlorine for this purpose, including Plainfield, N. J., Flint, Mich., San Bernardino, Calif., Schenectady, N. Y., Alliance, O., and Independence, Kans.

While stale and septic sewage can be deodorized with chlorine, adding less chlorine to the sewage while fresh will retard decomposition and production of offensive odors. Gases from the Milwaukee sludge drying plant have, for a number of years, been deodorized by chlorine and at less expense than by several other methods tried.

Los Angeles, Calif., recently adopted a novel deodorizing plan at one of the sewage lift stations within city limits, located within about 50 feet of an open air vegetable market. A fine spray of chlorine water in the pump sump was helpful, but more effective was the application of hypochlorous acid sprayed from nozzles. To effect this, chlorine water from an ordinary chlorinator is discharged upward through a tower filled with finely crushed limestone, whereby the chlorine is converted into hypochlorous acid. Mr. Enslow is responsible for this installation.

Relieving Pooling of Filters—Temporary application of chlorine has been found to free sprinkling filters of surface clogging and resultant pooling at Schenectady, N. Y., New Braunfels, Tex., Canton, O., Lackawanna, N. Y., and Elgin, Ill.; while bleaching powder has been similarly effective at Bloomington, Ill., and Rochester, N. Y. In addition to relieving pooling, such application seems to increase the efficiency of the filter.

It is suggested that by preventing filamentous growths in filters by chlorination, it may be possible to use smaller stones and increasing rates of sewage application. At Schenectady, drastic chlorination was followed by the maximum nitrification which has been obtained by that plant.

Chlorination of filters seems to reduce breeding of flies in them but not to afford sufficient control of the fly nuisance, the only remedy for this that is yet known being flooding of the beds, or possibly the use of certain insects such as spiders.

Of the chlorine applied to crude or settled sewage, a substantial amount, in some cases more than 90%,

enters into combination with substances in the sewage. This amount may be called the "chlorine demand," which must be satisfied before any appreciable amount can be available for disinfection.

The most economical way to use chlorine in filters is to apply it at night, when the weaker sewage has only about half the chlorine demand of day sewage and the rate of flow is less. The sewage as applied to the filter should contain 3 to 5 parts of residual chlorine or thereabout, usually requiring about 25 p.p.m. of the night flow. The doses are repeated nightly until the filters are clean. One thorough treatment per season seems to be sufficient.

Reducing Oxygen Demand. Results obtained by several investigators and plant operators indicate that chlorinating sewage reduces its oxygen demand, in some cases as much as 25%, the reduction increasing with the strength of the sewage. The effect is marked during the first 24 to 48 hours, and appears to persist for 20 days or more of incubation of seeded samples.

Mr. Enslow has suggested that the chlorine does not oxidize the putrescible matter but combines with unsaturated organic compounds to produce non-putrescible ones, many of which are themselves mild disinfectants. Dr. Rideal in 1904 observed bodies in chlorinated sewage which acted similarly to chloramines; and it is known that nitrogenous organic compounds upon decomposition exhibit a marked affinity for chlorine. Chlorination experiments during the past summer at Indianapolis seem to indicate that the effect of chlorination is not permanent, but simply one of inhibition.

If we can reduce oxygen demand 35% by sedimentation, it seems probable that we can increase this to 50% by chlorination. That such reduction may prove sufficient during limited periods, and when sedimentation alone will be insufficient, has been suggested by Baity, Rudolfs and Mohlman. Also, chlorination may be used advantageously during peak conditions which exceed the capacity of a plant; also when the stream has not a volume of flow to afford sufficient dilution at the outlet but has such volume further down.

Protection of Sewers. Hydrogen sulphide given off by sewage, converted to sulphuric acid, attacks concrete and mortar in sewers. This action has been prevented in Orange Co., California, by partial chlorinating of the sewage prior to its discharge into a long outfall sewer.

In Activated Sludge Plants. Several plants in Canada and that at Barnsley, England, have applied bleaching powder to the returned activated sludge to "correct disturbances in the process which result in inferior effluent." The Barnsley plant, where bleaching powder is applied to the crude sewage prior to sedimentation, also during 1929 for the first time could take care of the entire sewage flow during the summer.

It is reported that filtros plates have been cleaned by applying dry chlorine gas to the air manifolds. It has been suggested that a small amount, say 1 p.p.m. of the sewage, be so applied regularly during summer conditions.

Industrial Wastes. Chlorination of the effluent from precipitation tanks and trickling filters treating creamery wastes has proven beneficial in eliminating fungus growths from stream beds and preventing odor nuisances along the stream. In California and Arizona, creamery wastes used for irrigation are given moderate doses of chlorine to prevent decomposition on the land during the period of absorption.

Chlorine has also been used in connection with trickling filter treatment of packing house wastes at Mason City, Ia., and with recovery of paper mill "white water." Its use to break up emulsions of grease when these are present in sewage in large quantities, and to correct foaming in settling tanks, has been tried but the effect is not fully established as yet.

Cost of Chlorination

This will vary widely with the different uses and local conditions. The following cost analysis endeavors to furnish a basis for estimating the cost in a given case, whether for disinfection, odor control, pooling or reducing the B. O. D.

Chlorine. Chlorine is now available for purchase in 100 and 150 lb. cylinders, ton containers, and tank cars, the price depending upon the type of container and upon the distance of shipment or freight cost. With cylinders purchased as needed, the price will range from 6c to 7c per lb. of chlorine; with cylinders in carload lots from 4 to 5 cents per lb., while ton containers range from 2½ to 3 cents per lb., to which figures it is necessary to add the cost of freight in both directions.

Equipment. Machines with a 10 lb. capacity in 24 hours cost about $750, while machines with a capacity of 700 lbs. per 24 hours cost about $3,500. The variation in cost is more or less uniform between these limits.

Labor. The cost of labor or attendance and maintenance of chlorinating equipment is relatively small. Very seldom, and even where small quantities of chlorine are used, does this figure exceed ½ cent per lb. of chlorine used.

Cost of Disinfection. Requirements may vary from 50 to 90 lbs. per m.g. for crude, fine screened and settled sewage; from 15 to 25 lbs. for activated sludge or trickling filter effluent. The size of plant will affect the cost. For disinfecting the former class of sewage the cost is estimated at from $4.50 to $7 for plants averaging under 1½ m.g.d.; from $3.25 to $4.50 for those averaging between 1½ and 2½ m.g.d.; and from $1.75 to $3.25 for those with more than 2½. For the latter class of sewage, the cost would range from $0.50 to $2.50 per m.g.d.

Cost for Odor Control. With a range in quantity of chlorine required from 75 to 100 lbs. per m.g., and applying it 3 to 10 p.m. during 150 days of the year, the cost will be $0.50 to $2.50 per m.g. This figure would be substantially reduced if spread over the flow for the entire year. The cost at Plainfield last summer, averaging 98 lbs. of chlorine per day, was $1.42 per m.g. of sewage passing through the plant, which averaged 3.3 m.g.d. About 10,000 lbs. of chlorine was used during the year 1929 to deodorize stack gases at the Milwaukee sewage plant at a cost of $3,000.

Cost of Relieving Pooling. Assuming dosing during 12 hours of the night for six consecutive nights, at rates of 20 to 30 p.p.m., and sewage application of 1 to 2 m.g. per acre of filter, figures about 1,000 lbs. of chlorine per acre, which might be increased 50% for extreme cases. On this basis, the cost for filters

(Continued on page 54)

Essential Facts About Brick Pavements

Summarizing the important factors of this type of pavement in ready form for the convenience of city, county and state engineers.

By J. F. Coleman
Chief Engineer, Southern Region, National Paving Brick Mfrs. Ass'n.

THE more important economical advantages of vitrified paving brick may be grouped largely as follows: Long life; low maintenance costs; high salvage value; adaptability to repairs; low construction risks. There are many other minor features, such as being non-glaring, non-skid, smooth, and of pleasing appearance.

Long Life

The maximum length of life of brick pavement under normal traffic conditions has yet to be determined. There are numerous examples between thirty and forty years old still adequately serving the public and with many years of economical service still ahead of them. When it is considered that practically all of these pavements are laboring under the handicaps of obsolete design, such as cement grout filler, two- and three-inch sand cushion, inadequate drainage, improper preparation of subgrade and base (to mention only a few), and that the work incident to construction was that of a period of a third of a century or more ago, their durability and service is one of the outstanding achievements in the history of paving materials. Many of these pavements, in addition to the above, have had to survive the innumerable service cuts attendant on a generation of underground improvements.

A brick pavement in Holland which has given more than one hundred years of service

Modern manufacture, construction and design embody many features that will greatly increase the service life of brick pavements. These same features will also lend themselves to easier repairs, less maintenance, greater riding satisfaction and a greater relay value. The use of thin sand cushions allows less room for the displacement of individual bricks. Asphalt filler, by providing flexibility, reduces wear and practically eliminates cracking, heaving and chipping. This same resiliency of filler makes repairs and adjustments simple and economical, eventually assures a high salvage value and at the same time simplifies relay work.

Closer laboratory control of raw materials, improved manipulation by modern machinery and other progress in handling at plants have tended to improve the quality of brick and assure a more uniform product. The rigid tests of the "rattler" as a final check on manufacture acts as a further guarantee against inclusion of non-uniform or poor material.

With the improvements and safeguards in manufacture, tests and construction, as enumerated above, it is difficult to predict the maximum service to be expected of the modern brick pavement.

Low Maintenance

In considering maintenance costs, it should be borne in mind that statistics on maintenance as usually compiled by state and municipal departments have little real meaning. To be truly indicative of the economy of a material they must take into consideration several pertinent factors. Chief among these is the length of time the pavement has been in use; it is patently unjust to compare a seven-year-old pavement with one fifteen years old. Then, type of construction has a bearing on satisfactory maintenance service; it is but fair to assume that recently built pavements have benefited greatly by the progress in construction methods, including items that tend to reduce upkeep cost but which were given slight consideration a few years ago. Again, if the maintenance on two different types of pavement has not been of a uniform and like quality, the type neglected will after a number of years show a mounting maintenance cost that is not characteristic of and should not be charged to the material as a type. Also, the kind and amount of traffic exerts a decided influence on maintenance tabulation.

From the few items mentioned above it can be seen that, to mean anything and to be taken as a criterion of what one type of surfacing will cost to maintain as compared to another type, the following historical conditions must have been complied with: Basic construction conditions, such as drainage, subsoil conditions, and quality of subgrade, must have been equal or proper allowances made; maintenance must have been on a par, or, if not, so stated; construction methods must have been of equal quality and of a similar period; pavements of like ages only should be compared, or the mean age of each type stated; amount and kind of traffic should be stated where there is any material variation.

An experimental road containing eighteen types of pavement was constructed in 1911-12 by the Bureau of Public Roads, on the Chevy Chase road in Washington, D. C. Their figures on annual and accumulated maintenance costs, with proper explanations and allowances, are made every few years and are probbly the most reliable in existence and should be referred to for correct standards of comparison. The Bureau's record shows that of the 18 types of pavement laid on this experimental road, brick has the lowest cost of any.

Salvage Value

No one feature in the economics of paving is as important as that of relay value. The fact that a pavement, after a long period of service may be turned over at small cost and an equally long period of satisfactory service obtained from the other side is, in effect, getting two pavements for slightly more than the cost of one. This very desirable attribute of salvage is peculiar to the unit type pavement, and its advantages and possibilities are becoming generally recognized. Many communities are waking up to the fact that, though they have paid for only one pavement, in reality they have two and are realizing doubly on investments made a generation or more ago.

Our records show that brick pavements as old as thirty-eight years have been turned over at a comparatively small cost and are again serving the public. With the advantage of modern construction to offset the increase in traffic, these pavements should be adequate for another period of service as great as they rendered originally. Brick laid with asphalt or sand filler are especially adaptable to relay work, as they are easily taken up and cleaned; this work coupled with the cost of relaying is very small and the resultant work is satisfactory in every manner, any small variations in the thickness of the old brick being adjusted in the sand cushion under the roller.

Adaptability to Repairs

Brick lends itself to repairs with ease and economy. The repair of an asphalt filled or sand-filled brick pavement is simplicity itself—merely taking up and replacing the same material, and the labor and time involved are negligible. A square yard of pavement can be taken up, the cushion adjusted and the brick replaced by two men in fifteen minutes. Expenses for material are usually limited to asphalt filler on replacement. Neither expensive labor nor equipment is necessary. A patch is never unsightly, as it consists of the original materials only.

The objectionable features connected with repairing pavements—detours and barricades—can be reduced to a minimum in the case of brick pavements. Small patches can be made quickly and immediately given over to traffic, the barricading of a portion of the travelled way thus being limited to a few minutes only. Where major repairs are being made, only the section that can be completed in one day need be closed, and this opened to traffic the same night, thus doing away with dangerous night detours; while the fact that the repaired pavement can be used as soon as finished reduces to a minimum the length of time traffic must be detoured around it.

Brick pavement on Broadway, Columbia, Mo.
Laid in 1906. Not a cent for maintenance since then

Construction Risks

Construction risks are greatly reduced by use of a unit-type pavement. The material is accepted as to dimensions and other characteristics before it is received on the job, cannot deteriorate before it is laid, and thus reduces to a minimum the possibility of rejection of any part of the finished pavement, taking the creases out of the brow of the contractor. Minor adjustments to the surface are made easily without loss of material.

Smoothness

Tests conducted on modern asphalt-filled brick pavements have shown that they easily can be constructed to attain modern demands for smoothness. The most notable of these tests was that supervised by P. M. Tebbs, assistant chief engineer of the State Highway Department of Pennsylvania, and is illustrative of the findings obtained on modern construction. On a thirteen and a quarter mile project on the Steubeville Pike leading into Pittsburgh, U. S. Route No. 22, completed in 1929, roughometer tests conducted by the Pennsylvania Highway Department showed an average reading of 18.6 cumulative inches per mile of bump and depression. One section of this road was as low as 13.8.

(Continued on page 70)

Brick pavement on William Penn highway, Pennsylvania
Laid in 1929. Remarkable for its smoothness

Construction of the Moccasin Dam

THIS dam will create the Moccasin Re-regulating reservoir, to be used in connection with the generation of power by the Hetch-Hetchy water supply system of San Francisco. The dam is of earth and rock fill, with a concrete core wall.

The core wall was constructed in 5-foot vertical lifts and was kept at all times 15 to 20 feet above the earth fill. The concrete was placed from a 120-foot tower erected at the upstream toe, from which it was chuted to a hopper on the runway over the core wall and dumped into the forms by buggies. Bolts were inserted into the concrete to support the posts of a double runway trestle, used to set the forms as well as support the buggy runways; which trestle was raised five feet at a time as lift after lift was completed.

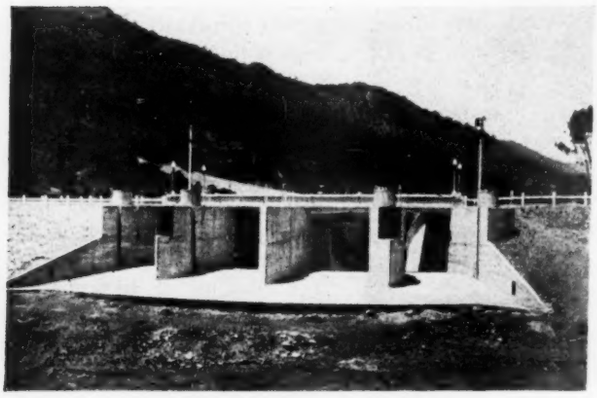
Before concreting of the core wall began, 3-inch drill holes 20 feet deep, spaced 10 feet centers, staggered upstream and downstream, were drilled at the bottom of the core wall trench at an angle that cut the stratification. Two-inch pipes were inserted in the holes, calked tight with lead wool, and the pipes led through the sides of the form. Prior to placing the concrete in the bottom of the trench, secondary grout pipes in the shape of an inverted T, with the legs 5½ ft. long, were placed along the upstream face of the core wall on 13-ft. centers; the ends being covered with loose rock to prevent the concrete from plugging the pipe. The purpose of grouting through these pipes was to take up any concrete shrinkage and thus insure a perfect bond between the concrete and bed rock. The secondary pipes were grouted first, using a maximum pressure of 40 lbs. per sq. in. The primary pipes were then grouted under a maximum pressure of 100 lbs. The grouting operations used 3055 sacks of cement, neat cement grout being used.

Material for the fill was excavated from the reservoir basin adjacent to the power house. The material was loaded into trucks by a 1-yd. model 34 Marion steam shovel and a 1-yd. Erie gas shovel and hauled to a central screening plant with a grizzly of 3-in. openings. The screened material was elevated by means of a 36-in. conveyor belt to a bunker, from which trucks drew it out and hauled it to the dam for the rolled clay fill, where it was spread in 6-in. layers, using three No. 30 caterpillar tractors with McMillan bulldozers, wetted, and rolled thoroughly with a "sheepfoot" roller. The rejects from the grizzly were loaded into trucks and hauled to the upstream and downstream toes, which were of rock fill.

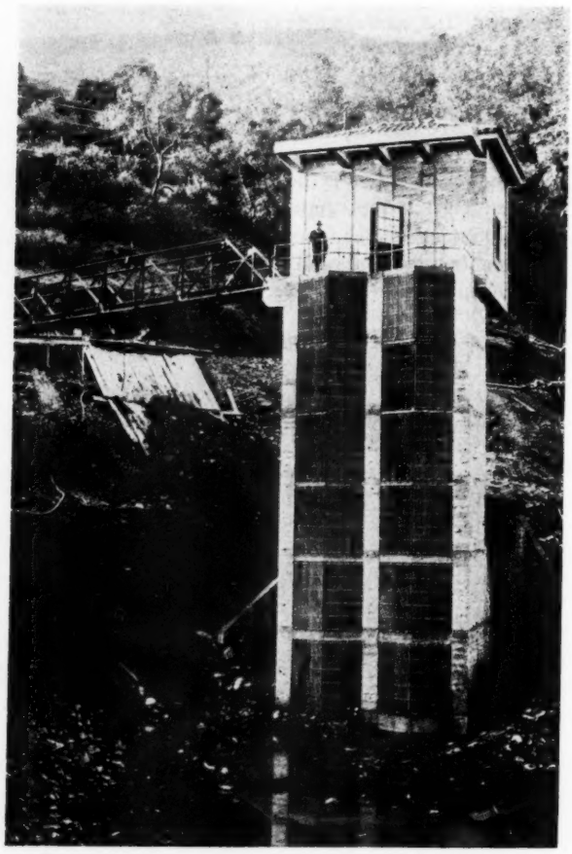
The rolled fill section of the dam is in the shape of a prism on each side of the core wall, with a crest

(*Continued on page 43*)

General view of dam. Upstream face at right.



Moccasin dam spillway. Gates to be installed later.



Main outlet tower, at intake of tunnel, Moccasin re-regulating reservoir.

THE EDITOR'S PAGE

The Annual Report

About this time of the year most city engineers, water works superintendents and other officials in charge of public works and utilities are engaged in, or have just completed, preparing an annual report. Most of them, we fear, look upon this as a nuisance and a waste of time which might better be devoted to the performing of actual work. Their reports are likely to prove to be, in reality, a waste of time.

But those who recognize in the annual report an opportunity to explain to the taxpayers the work which they have done with the funds allotted to them, to interest them in the needs of their department if the city is to continue to be one of which they are to be proud and if the services rendered are to be satisfactory—these officials, if the report is intelligently prepared, will find the preparation of it to have been the most worth-while work they do during the entire year.

If conducted with reasonable efficiency and economy, the public work construction and the operation of public utilities return to the tax payer more value for his dollar than any other purpose for which he spends his money. If this is demonstrated to him in a report which is not over his head but is interestingly told and presents the facts convincingly, not only will the official win greater respect for himself and appreciation of his work, but he will find that his requests for funds for the coming year are met more freely and liberally.

Remedy Unemployment by Useful, Not Useless Labor

The editorial in our January issue expressing the opinion of our editorial department relative to certain unemployment relief methods has been endorsed by a number of municipal engineers, some expressing themselves quite emphatically in their letters to us. As an illustration, we quote from a letter received from one of the leading city engineers of the central states:

> It might be stated that President Hoover started the ball to rolling about a year ago when he made his recommendations for what was called "Plan Prosperity" through encouragement of public improvement construction. This was eagerly seized by the public press and played up to the utmost so that public opinion crystallized itself in all sorts of welfare agencies around this idea as being the solution of the whole matter. The net result is a sort of mob hysteria extending even into Congress to such an uncontrolled degree that President Hoover this year sent a note of warning to Congress.
>
> It seems to me that the time is ripe for a reversal of form in public propaganda such as you are proposing in your editorial. It has not only reached the stage where speed is being urged on all bodies having to do with the financing of public improvements without any regard to whether or not plans have been well digested, but people have become so lost to all sense of balance in spending public money that contracts are being actually let on the basis of reversal to hand methods of construction. One city of which I know is literally wasting $25,000.00 or $30,000.00 in this way.
>
> The situation is the more critical in that there is a popular clamor everywhere for reduction in public expense because of the ever mounting tax burden. People who are insisting that public funds be provided to take up the slack in unemployment regardless of the need or benefit of the work being done are among the most insistent that taxes be reduced regardless of method of reduction.
>
> Many cities have already reached their bond limit and limit of taxation and others are rapidly approaching that most undesirable condition, so that it seems that now, if ever, public expenditures should be scrutinized even more carefully than at any other time and that no construction of public improvements should be undertaken except according to well digested plans and definite needs of the cities which undertake them. The whole procedure is a sort of vicious circle in which money is unnecessarily extracted from the taxpayer's pocket over a term of years in a vain attempt to put it back through the medium of payrolls and merchandising channels into his other pocket at the present time. This argument is especially strong in those cases where improvements are done at the expense of a special benefit district in which the power of municipalities to tax is used to sort of half conceal coercion compelling certain districts to donate money unnecessarily for charity's sake.
>
> These rather positive statements, of course, do not apply to those projects which are needed in the immediate future for which plans are well digested and methods of financing definitely worked out because, from the standpoint of the municipality, commodity prices are low, labor is plentiful to do the work, and the bond market is especially favorable.

The public works official owes it to his community to direct the charitable intentions of other officials and the taxpayers in such way as to furnish additional work immediately, without waste of money on unneeded projects or uneconomical methods. What was done in California is described below.

As soon as unemployment reached noticeable proportions in California, the director of the State Department of Public Works, Bert B. Meek, used the department's organization for affording immediate relief. He planned the establishment of five labor camps to give highway work to at least a thousand men; meantime authorizing each division of the commission to add to the number of men on its maintenance crews. Plans and specifications for contemplated work were rushed to completion and bids called for sooner than intended so that actual construction would begin as soon as possible.

Reports of Saturday, December 20th, showed that the state highway department was giving employment to 3,107 men in addition to the customary force. Of these, 1,732 were at work on relief maintenance crews working from more than two hundred centers, on a three-days-a-week basis at $4 a day, providing their own board and lodging. "The work assigned to them is that which lends itself to the use of a maximum of hand labor and a minimum of machinery," said the official report. The men so employed are certified to by community relief agencies as bona-fide residents of California and in great need of employment.

The unemployed in the metropolitan areas are distributed among the five camps, each holding 250 men. They were selected by the state's free employment agencies as residents and in great need of labor, and given board and lodging and $3 a day. In addition, a special construction crew of 125 men was working on the Carmel-San Simeon highway.

Abstracts of Papers at the American Road Builders' Convention

As in previous years, we are giving, for the benefit of those who were unable to attend the A. R. B. A. meeting at St. Louis last month, brief abstracts of most of the committee reports. In later issues, as space permits, we will give abstracts of some of the papers which seem to be of most general interest. The reports and papers generally seemed to us to have more than ordinary merit this year.

City Officials Division

SESSIONS for reading and discussion of papers were held separately by the City, County, and Manufacturers Divisions, and these abstracts of the reports will be similarly divided, beginning with the City Officials.

Assessment Methods for Paving

By CAPT. H. C. WHITEHURST, *Engineer of Highways, District of Columbia.*

During the summer of 1930 representatives of the City Officials' Division studied the practices followed in making assessments for paving by seventeen representative cities—New York, Chicago, Philadelphia, Cleveland, Baltimore, Washington, New Orleans, Kansas City, Indianapolis, San Antonio, Louisville, Memphis, Oklahoma City, Richmond, Des Moines, Jacksonville, and Galveston.

CONCLUSIONS

The following conclusions are presented as a result of this study:

(1) Established practice in making assessments varies in detail, but the general plan of assessment is similar in most cities. The following points of similarity are noted:

(a) Street railway paving is not paid by the city.

(b) The entire width of street is usually assessed.

(c) The city pays for heavy grading in most cases.

(d) Alleys and sidewalks are paid for by the abutting property owners.

(e) Intersections are paid for by the city in half of the cases studied.

(f) The practice of property owners specifying the type of pavement is by no means universal. In most cases the city retains discretionary powers in the selection of types.

(g) Assessment warrants are generally used for payment. Funds are not usually collected in advance.

RECOMMENDATIONS FOR STANDARDIZATION

(1) That city officers have discretionary powers in the selection of type.

(2) That intersections be paid for by city from general paving funds.

(3) That on pavements of excessive width, part of the cost come from general paving funds.

(4) That payment be made to contractors in cash from city funds.

(5) That repaving of surfaces 20 years or more in age be by general assessment; of less age, largely from general paving funds.

Paving Practices of Cities

Design and Construction Committee; Chairman, GEORGE B. SOMERS, *Commissioner of Engineering and Construction, Cleveland, O.*

This is a summary of replies from more than 150 cities to a questionnaire on paving practice—most of them the smaller cities.

Probably the most outstanding conclusion, based upon the letters which we have received, is the one that all of the city engineers seem to be well satisfied with the results which they are getting from their paving. An optimistic tone pervades all of the letters, yet each engineer seems to be looking for something new and better with which to improve his practice. Many of them are limited in kinds of pavement by scarcity of local paving materials or of local contractors skilled in laying different kinds.

Asphalt surfaces of one type or another seem to be the most widely used of all pavements, in all climates and all sizes of cities.

Los Angeles is substituting various types of non-skid bituminous concrete surfaces for sheet asphalt, which has been discontinued. San Diego, Calif., also uses non-skid pavements. A few cities still use asphalt and tar penetration macadam because of low construction cost, in spite of higher maintenance cost; in one city, at least, because construction cost is paid directly by the abuttor and maintenance by the city. Black base is increasing in popularity, especially in cold climates.

Portland cement enters into the pavements of almost every city or town; many small ones use cement concrete paving surfaces almost exclusively. There is the greatest variation in the laying of these—with or without reinforcing, curing by various methods, etc. Lean concrete is generally used for pavement bases.

Bricks, when laid on concrete foundation, are most commonly laid with asphalt as a joint filling material. In a number of places they are laid directly on the natural sand subgrade; Florida cities find such construction highly satisfactory, using sand, tar, asphalt or cement grout for filler.

Durax granite blocks are used successfully and economically in Winston-Salem.

Crushed slag is found a very useful and cheap paving material in areas where iron ore is smelted. Warren, O., has used it very satisfactorily under block and asphalt pavements.

Wood block is about obsolete for city streets.

Discussing expansion and contraction joints in concrete, the author says that Pittsburgh is experimenting with a cork expansion joint. Kent, O., uses a ¾-inch air joint every 30 feet in a concrete base, formed by a board set vertical in the concrete and then removed; the opening being covered with a layer of tar paper before the bituminous surface is laid. Monessen, Pa., is using ½-inch expansion joints in concrete bases filled with a 9:1 mixture of sand and cement, placed in the joint dry.

Practice of several cities in connection with paving along street railways was described briefly. In Cleveland the railway company is required to build the track structure and maintain the pavement, while the city must pave the track area. In two cases last year the company used 7-in. grooved rails on wood ties, which rested on slag macadam, and filled between and over the ties with concrete, settled by use of a track vibrator, and reinforced with six ½-in. steel bars laid parallel with the rails. On this, 2½-in. brick were laid. The pavement in the track area was separated from that in the roadway by a steel angle guard set in the base at the end of the ties.

Charleston, S. C., used an asphalt pavement in the track area with two lines of vitrified brick laid parallel to the rails.

Madison, Wis., places a ¼-in. expansion joint between the pavement in the track area and that in the roadway.

Relation Between Increased Highway Expenditures and Employment

By C. E. MYERS, *President, City Officials' Division and Director of Transit, Philadelphia.*

Judging by expenditures in past years, the expenditures for pavements in cities during 1931 probably will exceed one billion dollars. Expenditures by years for city streets in cities of more than 30,000 population, according to U. S. Bureau of Census figures, were:

1922	$299,048,894
1923	324,606,952
1924	374,442,412
1925	450,712,261
1926	483,946,930
1927	552,161,174
1928	548,523,612
1929 (ARBA Estimate)	550,000,000
1930 (ARBA Estimate)	560,000,000

Expenditures in some 4,000 cities of less than 30,000 population in the United States are probably in excess of the total of the 225 cities of more than 30,000 population.

Most cities find it difficult to raise emergency funds for alleviation of unemployment. Borrowing from local banks in anticipation of taxes may be possible. Emergency funds loaned or given from county, state or national sources would help. Probably a large part of the federal funds made available by Congress for public construction will be expended in or near cities.

There are sound economic reasons for the expenditure of unemployment relief funds in cities. For unemployed men and women flock to cities looking for jobs, and a tremendous burden is placed on the city charitable organizations; those living in cities should not have to spend any of their too small income in traveling elsewhere for work; the work done in cities, especially on pavements, benefits more people than in other areas.

Pavement construction and snow removal readily absorb men from industries temporarily inactive; and until these become active again, the simplest and most easily applied relief measures are pavement construction and maintenance, snow removal, and installation of traffic control devices or construction of grade separations.

Maintenance

Chairman, A. T. RHODES, *Superintendent of Streets and Sewers, Leominster, Mass.*

The following tentative conclusions and recommendations were presented by five sub-committees, based on studies made of twenty cities by personal visits and questionnaire; the cities extending from Florida to Massachusetts and from Texas to Wisconsin. The reports themselves were brief abstracts and are given herewith in full.

Surfaces of All Types

Presented by W. W. MYNATT, *Director of Public Service, Knoxville, Tennessee, Chairman.*

1. Trained and experienced supervision to obtain adequate and low cost maintenance.
2. Recognizing the age at which the investment becomes economical and holding the maintenance cost down.
3. The same caution must be taken in selecting the material for maintenance as the original material for construction. Too little attention is paid to selecting maintenance material.
4. When pavements fail, they should be investigated, the cause noted and corrected immediately, thus preventing further failure.
5. Most failures result from improper supervision during construction and not from the design and material. Details frequently overlooked in the construction of asphalt and concrete pavement are the proper rolling of subgrade and proper spading of the material at joints, gutters and manholes which result in water penetrating the surface material and causing the subgrade to fail.
6. Good equipment and skilled labor are good investments for maintenance of all paving.
7. In most instances, the pavement is allowed to go without proper maintenance until it has reached the point at which repairs become the most expensive operation. A few dollars expended efficiently in maintenance work at the proper time will save much money. Maintenance in cities of pavement under heavy traffic is necessary to preserve the investment, and the work must be done with the least possible inconvenience and hindrance to traffic. To accomplish this result, careful planning, skillful manipulation and adequate equipment are necessary.
8. More attention should be paid to repair methods, which will allow quick resumption of traffic. (a) with stone or brick, accelerators in cement fillers are not given enough consideration. (b) Asphalt mastic is desirable for quick opening of streets with stone or brick paving. (c) Cold mixed preparations seem to have the preference over hot mixes for patching. (d) Preference for bituminous fillers is shown for brick pavements. (e) Sheet asphalt is useful for surface maintenance on brick, stone blocks, cement concrete, or bituminous concrete. (f) Tars seem to have the preference over either light or heavy oils for blanket maintenance.

Street Openings and Cuts

Chairman, R. A. MACGREGOR, *Engineer in charge of Maintenance, Borough of Manhattan, New York City.*

1. All public utilities should be installed before paving.

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Water Works Literature of the Month

By Isador W. Mendelsohn, C. E. Design

Design

GRAVITY-TYPE dams[5] in progressive development from the enormous masonry cross-section used by ancient engineers to the modern thin reinforced-concrete ambursen and multiple-arch types show continued increase in economy of material, also progressively smaller amounts of uplift to which the dams may be subjected. To keep the sliding factor within safe limits, the upstream face of the lighter types must be built on a slope, so that the water overlying the face supplies the additional weight required against sliding.

The reciprocating bucket pump[13] gives good efficiency and satisfactory performance where low rates of deep well pumping are required, and is used most satisfactorily in private systems. Its disadvantages are difficulty of maintenance when sand is encountered, when pump rods cannot be suspended straight and vertically, and where high rates of delivery with high lifts are required. Where the rate of pumping with centrifugal pumps is reduced by throttling the discharge valve, losses are involved due to the additional head pumped against and to the poor efficiency rate at which the pump is operated.

Advantages of air lift pumps[13] for wells with air supplied by modern efficient steam-driven air compressors located at a central plant are: (1) Duties favorable to the system; (2) low first cost; (3) low maintenance cost; (4) accessibility of working parts; (5) reliability; (6) aeration of the water; and (7) satisfactory use in unit well installations. Its **disadvantages** are: (1) Need for considerable submergence of the eduction pipe; and (2) impracticability for some shallow wells. Improper submergence depths and unnecessary resistance to flow at the top of the eduction pipe result in losses seriously influencing operating costs.

The turbine deep well pump[13] will give good efficiency, can pump directly into the mains where ground level pressures are not too high, and with automatic control requires little attendance, having an advantage in this over an automatically controlled electric motor-driven air compressor and air lift pump on a unit well installation. Its disadvantages are short life and high maintenance cost in certain wells, especially where sand occurs in the water.

According to L. A. Smith, a combination air lift and centrifugal pump was used at Madison, Wisconsin, in preference to the deep well turbine pump, even though the latter is more efficient and is operated at a lower cost, because of these reasons: (1) The water contained sand which reduced the efficiency of the deep-well pumps to 1 to 3 percent annually; (2) aeration of the water removed the iron, preventing red rust in the distribution system; and (3) the moving units are always open for inspection, while the turbine pump is in a well, necessitating in the latter case an auxiliary unit for constant operation in case one turbine is undergoing material repairs.

Service pipe should be selected[14] according to original cost, probable life, past performance, and estimate of future performance. In Kenosha, Wisconsin, the minimum size service is ¾ inch and of copper, the services from ¾ to 2 inch inclusive are lead, and from 2 inch up of cast iron. Galvanized pipe is not permitted for services due to short life. The water department constructs all services between the main and the curb line at the expense of the property owner; and the property owner through his plumber continues the service from this point. The department should determine the size of the service based on the consumer's plans.

Water works pump installations,[1] either operated by electrical power in large plants to save in labor cost over steam-driven pumps or by Diesel engines in small plants to save in cost of electric current, have furnished improved service at a saving in operation, combining water, light, and power plants has resulted in a reduction of labor costs and more economical and efficient use of pumping equipment.

A comprehensive distribution system for Greater Detroit[10] to supply 3,500,000 people has been developed logically from a single intake utilizing 3 widely separated pumping stations with 1.5 m.g. capacity elevated steel storage tanks, based upon detailed data as to the future growth and requirements of the city, and this system is being fitted in with the present water system. According to Louis E. Ayres, the early studies considered filtration for all additional supply at or near the source, but fear that possible infiltration of ground water into tunnels when out of service might prove a source of contamination resulted in the decision to carry raw water only through concrete tunnels in clay. The general rule is to use steel pipe for diameters larger than 36″ and cast iron for 36″ and smaller.

The development of the Greater St. Louis water distribution system[11] for 1,400,000 people from 2 intakes and 3 pumping stations and reservoirs into a program of 5-year periods of construction up to 1955 will result in: (1) Great savings in fire insurance premiums; (2) marked reduction in business, employment, and property damage losses; (3) maintenance of higher health standards; (4) better service; (5) economies in street maintenance work; and (6) prevention of water shortages.

The development of the Chicago water distribution system[11] according to J. B. Eddy was, like Detroit and St. Louis, based on a 25-year plan, the data for which were obtained from: (1) U. S. census figures, past and projected into the future for each square mile; (2) an occupation survey for each sq. mi. from record at losses of the Building Department and a field inspection every 5 years; (3) pitometer surveys for each sq. mi. in the city proper and meter readings for all outside towns and other consumers metered at the city limits; (4) yearly trunk line surveys made by pitometer and pump slip tests made every 5 weeks; (5) meter flow curves for all classes of consumers; (6) study of all metered services in the city by classes; (7) fire flow tests made in each ¼ mile area at least once in 5 years, and the decennial survey of the National Board of Fire Underwriters; and (8) information from utilities, railroads, and consulting engineers.

Construction

Core material tests on the Germantown Dam[6], one of the 5 hydraulic-fill retarding dams of the Miami Conservancy District, were made by sinking a shaft 12′ from the center line of the dam at a point where its height was 110′, and by drilling a hole on the opposite side of the center line within about 25′ of the shaft. The results showed: (1) The core material is well graded from fine sand to clay in a well proportioned combination, and practically free from flat particles which would increase its compressibility; (2) the water content of 25 percent is practically the same as that found at the end of the construction of two other dams of this group, indicating very little change in the core since construction; and (3) the drilled hole samples were as satisfactory as those from the shaft and were obtained at a much smaller expense.

The method of core testing[7] used on an earth and rock-fill dam built by the semi-hydraulic-fill process consists of collecting samples during construction by means of a special pole with a jar at the bottom and analyzing them in the laboratory. The composition of the core is best observed by placing a large-size sample in a quiet place and allowing it to dry for months, if necessary; then breaking it, and examining its cross-section. Samples are taken on lines perpendicular to the center of the dam, beginning at one end and continuing at about 25′ intervals to the other. In every instance one sample is taken close to each beach and one from the center of the pool.

The materials of major earth dams[8] of the country are being studied by the U. S. Bureau of Reclamation in the light of the history of each dam during and following construction. Tentative charts indicate the approximate limit of materials suitable for impervious sections of rolled fill dams, approximate upper limit of size for tight hydraulic-fill dams, and possible limit of satisfactory core material for hydraulic-fill dams. The materials of successful dams vary greatly in size, the finest 30 percent being coarser than 0.0055 mm. and the coarsest 50 percent larger than 0.35 mm., or a size ratio of 1:64.

The Wanaque Water Works Project[28] obtains water from the Wanaque river, an upper tributary of the Passaic river, with runoff from an area of 94.4 square miles impounded in a reservoir with storage for 29,600 m.g. The yield of 100 m.g.d. is conducted to a group of 8 municipalities in the North Metropolitan area of New Jersey through an aqueduct 20 miles long, consisting mainly of a 74″ twin steel pipe line. Construction work was begun in 1920 and sufficiently completed in 1930 to deliver water at the end of the aqueduct. The total cost will approximate $27,000,000.

New York City water tunnel No. 2[2] is being developed through solid rock by electrically driven equipment, such as centrifugal blowers for the removal of powder gases and supplying fresh air to working heads, direct-current motors for 16 balanced cage hoists, synchronous motors for high-pressure compressors, squirrel-cage motors for centrifugal sump-pumps, battery-operated mucking locomotives, motor-operated skip-hoist mucking machine, and electrically driven, centrifugally operated machines wherever possible to eliminate noise.

Deep wells are being developed[23] to a depth of over 1000′ by the Los Angeles Water Bureau in the southern part of the city. A screw pump driven by a 6 cylinder 125 hp. tractor engine is used because of the flexibility of speed of a gas engine. At the beginning of the development this provides a minimum speed to prevent the well from breaking suction and thereby depositing sand in the bottom of the casing. Perforation of the wells is very important and is carried out by the rolling disc type of perforator which cuts 6 rows of holes simultaneously, and the single blade type which requires an individual operation for every hole cut.

Purification

Purification of highly turbid waters[9] having over 1000 p.p.m. turbidity depends upon the range and sharpness of the variations in turbidity and suspended solids as well as the quantity of mud and sand. Based on turbidity and coefficient of fineness of suspended solids, the various steps in the treatment of each class of these waters are given both for softening with clarification and for clarification alone. Indicative of these procedures is the present treatment of the Missouri river water at the Howard Bend, St. Louis station, including: (1) Two hours presedimentation in 2 Dorr basins aided by the return of all the sludge ejected from the coagulation basins; (2) dosing with milk of lime (and iron sulphate or alum solution at times); (3) conditioning for 20-30 minutes in 4 tangential flow circular tanks; (4) sedimentation for 2 hours in 2 Dorr basins; (5) the addition of alum as secondary coagulant; (6) 13 hours sedimentation in 2 plain basins operating in parallel; (7) 10 minute carbonation; (8) another dosing with alum; (9) conditioning for 20 minutes in a baffled basin; (10) filtration; and (11) chlorination.

Preliminary sedimentation[9] considerations relative to highly turbid waters are: (1) A grit chamber is usually unnecessary if the settling basins have mechanical cleaning devices; (2) with a coefficient of fineness greater than 0.7, the water will generally settle without chemical aid to a turbidity of 500-800 in 3-5 hours; (3) preliminary sedimentation reduces the turbidity variation in the water receiving the chemicals and effects savings of 0.05-2.5 grains of lime and 0.05-3.5 gr. of coagulant per gallon; and (4) the cost of raw water in cleaning presedimentation basins is only ½-¼ that of treated water.

Basin design[9] should provide for a wide margin between critical and working components of velocity, and for a proper depth in accordance with the turbidity load. Continuous basin clearing is very desirable and is possible with the use of hopper bottom basins, a pipe underdrain system, or some mechanical basin cleaner. Operating difficulties with the Dorr clarifiers are: (1) In case of a stoppage, it is impossible to start the mechanism unless the basin is drained and hand cleaned; and (2) operation of the clarifiers in winter has been unsuccessful due to ice jams. Sludge removal from Dorr clarifiers should be by at least 2 pipes, the combined capacity of these being equal to the maximum flow. Sludge from the coagulation basins is returned by water jet eductors to the raw water entering the presedimentation basins because it accelerates sedimentation 10 to 50 percent.

Chemical dosage[9] for good coagulation is best performed at a p H of 8.0., necessitating the use of a small amount of lime. Where softening is obtained in addition to clarification, the excess lime treatment has these advantages: (1) increased softening when followed later by carbonation; (2) coagulation due to the precipitation of magnesium generally makes the use of iron and alum unnecessary without increasing the non-carbonate hardness; (3) with a detention of over 12 hours, a high degree of sterilization is given the water

before filtration; and (4) the cost of the treatment including carbonation is frequently less than the lime and iron or alum without carbonation. Splitting the lime dosage so as to give the raw water a small charge increased the usefulness of presedimentation basins with an inappreciable waste of chemical. For highly colored, highly turbid waters, clarification alone, with alum and lime must be accepted, if plant design does not permit softening after clarification. Except in this case, iron sulphate has proved more economical than alum for primary coagulation of Missouri and Mississippi river waters. The optimum mixing period for lime softening is too long for iron or alum coagulation, necessitating addition of the coagulant last with little agitation.

Conditioning of the water[9] by multiple or series tanks equipped with variable speed mechanical agitators of the impellor or paddle type is favored.

Carbonation[9] is essential in the satisfactory lime softening of any water to neutralize the causticity of the water so treated, and carbon dioxide is the cheapest and most desirable acidifying agent available. At St. Louis, flue gas from the combustion of coal in a modern steam generating plant is scrubbed for removal of sulphur, compressed by a rotary water sealed pump, and applied to the water through a perforated pipe distributor, the tests showing only 0.2 per cent CO_2 by volume in the spent gas escaping from the water. Carbonation is applied 4 to 6 hours before filtration, together with a small dose of alum to facilitate the settling of precipitated $CaCO_3$.

Chlorination[9] of a highly turbid water is a wasteful procedure, and prechlorination of the settled water is not warranted when the excess lime treatment with over 12 hours contact is used. In this case, chlorination is reserved for the filter effluent.

Prechlorination experiments[20] at a fully equipped water filtration plant at Cincinnati carried on by the U. S. Public Health Service from July, 1927, to October, 1928, inclusive, gave the following results: (1) Raw water chlorination, when properly controlled, affords an effective and economical means of reinforcing the bacterial efficiency of rapid sand water filtration processes, the experiments indicating that the permissible density of B coli in the raw water (10,000 per 100 c.c.) could be slightly more than doubled by use of this measure; (2) maintenance of a controlled low residual chlorine in the applied water, averaging 0.05 p.p.m. and not exceeding 0.10 p.p.m., gave more consistent and in general more satisfactory results than did superchlorination, with a high residual chlorine in the applied water averaging 0.6 p.p.m. and ranging as high as 1.2 p.p.m.; (3) the bacterial efficiencies of filtration and of postchlorination appear, from these observations, to be measurably reduced as the result of prechlorination. From a practical standpoint, this disadvantage appears to be outweighed by the advantage of No. 1, but should be considered in judging the performance of perchlorination; (4) although the length of filter run was not increased by prechlorination under the conditions of these experiments, the development of growths of microscopic organisms was perceptibly retarded by this treatment; (5) the application of prechlorinated water to rapid sand filters appears to lower the bacterial content and the biochemical oxygen demand of the filtering medium. Variations in both of these elements were found to bear a fairly definite relation to concurrent variations in the residual chlorine of the applied water; (6) it is advantageous to prechlorinate before, rather than after, preliminary sedimentation in order to utilize the stabilizing effect of basin treatment prior to applying prechlorinated water to filters; and (7) even with the stabilizing influence of such basin treatment, careful technical supervision and laboratory control are necessary to maintain a relatively constant chlorine content of water applied to filters, which appears to be a desirable condition for consistently effective filtration. Although the ability of well-ripened filters to absorb excessive amounts of chlorine for considerable periods of time constitutes a valuable operating factor of safety, in so far as the production of overchlorinated effluents is concerned, any undue burdening of filters with excessively chlorinated water may be expected, as shown in these studies, to result in a measurable impairment of their bacterial efficiency.

Recent progress in water purification[3] includes (1) artificial aeration to prevent the production of objectionable odors, remove carbon dioxide, and oxidize the iron in ground waters; (2) use of slow filters to obtain a good water from highly polluted sources as at Chester and Philadelphia, Pa., and of slow filters with a deposit of ferric hydrate on the sand grains to remove the color from the water; (3) coagulation with ferric chloride for certain waters, and coagulation, filtration, and the addition of an alkali to prevent corrosion for soft waters; (4) complete mixing of the water with the coagulant by the use of the hydraulic pump, diffusing outlets, baffled channels, etc.; (5) water softening; and (6) the design of rapid sand filters, such as for high velocity wash of sand.

The new Fort Dodge, Iowa, water purification plant[24] treats the deep well water in a cascade-stream-flow aerator, chemical agitation basin, spirovortex chemical mixing tanks, settling basins and recarbonation chamber, and 4-1 m.g. rapid sand filters. Tests with a $600 experimental plant indicate the 550 p.p.m. of hardness may be softened to 100 p.p.m. and all the iron removed at a total cost for chemicals including recarbonation of 4.5c per 1,000 g.

Flocculated matter[22] in coagulated water decreases in strength with lower water temperatures, and where the temperature is below 4°C, it penetrates quite deeply into the sand filter beds, eventually passing through if the loss of head is high enough. The objections to the passage of flocculated matter through filters are: (1) the water is not clarified perfectly; (2) the matter settles out in the clear water reservoir and in the mains; (3) there is a tendency for the finer masses to again flocculate into larger noticeable masses; (4) if the water is not chlorinated prior to the addition of the coagulant, bacteria in the suspended particles are not so easily killed by the chlorine. Floc detectors should be used on each filter to determine the passage of any matter. For good filtration, the total turbidity of the filtered water should not exceed 0.2 average a day.

Tastes in the Hamburg, N. Y., water[31] due to spirogyra and ulotrix in spring, asterionella and synedra in summer, and synura and protococcus in the fall, were eliminated by applying powdered activated carbon. The carbon is carried from a hopper tank by a small stream of water to a small pump which delivers it by a spray nozzle into the current from the settled water pipe. The carbon dosage is .05—.0075 g.p.g. At the time the carbon is added, the raw water is prechlorinated to a residual excess of 0.4 p.p.m. and the filtered water to a residual of 0.1 p.p.m. The filter runs were normal after carbon use. This treatment proved economical according to the writer.

(*Continued on page 41*)

(*Continued from page 38*)

Successful clarification of water[12] depends upon proper coagulation preceding filtration. Mechanical agitation of the water just after the addition of coagulants results in: (1) Reducing the detention period in settling tanks from 4-6 hours to 2 hours or less where the floc forms slowly, as the formation of the floc is hastened and its stiffness increased so that the mat formed on the filters is not easily broken; and (2) greater reduction of turbidity and color in the settling tank due to better flocculation, thus relieving the filters and increasing their runs.

Vertical steel cylindrical settling tanks[12] have the following advantages over the horizontal type: (1) Less expensive for moderate size industrial installations; (2) occupy less floor space; (3) permit easy desludging; (4) settled water in the top of the tank may be used as a gravity wash-water supply for the filters; and (5) saving in water pressure where the raw water supply is used under pressure for other purposes in the industrial plant.

Water softening for boiler feed purposes[12] presents the following considerations: (1) the cost of distilling water by the use of evaporators averages 55c per 1000 g., whereas the cost of treatment by hot-line or zeolite is under 5c per 1000 g.; (2) use of water softening ahead of evaporators keeps them clean and maintains their capacity and keeps hardness from the boiler, due to priming of the evaporators; (3) hot-lime soda treatment, producing an effluent with 1.5 g.p.g. hardness, is insufficient for high-pressure boilers, necessitating the use of phosphate afterward, and increasing the operating cost; and (4) a comparison of zeolite and hot-lime soda treatment on a typical water like Lake Michigan shows that zeolite treatment has lower operating costs, lower hardness in the effluent and avoids the suspension in the boiler salines which are present in the case of hot-lime soda.

Management

The drought's effect upon Pennsylvania water supplies[19] was serious, especially in the south central, southwestern, and southern border areas. The flow of streams virtually ceased, leaving water works intakes dry with suction pipes exposed, and storage reservoirs empty. The State Department of Health immediately instituted measures to safeguard the public health, such as: (1) a warning was broadcast through the newspapers against use of questionable water supplies; (2) telephone inquiries were made of county medical directors as to existing typhoid cases and possible outbreaks, and early reporting of any suspicious cases was urged; (3) public health engineers were sent to the seriously affected areas (a) to institute water conservation measures, (b) notify the public through the press, churches, and hand-bills of precautionary measures, (c) assist in developing new supplies, (d) chlorinate auxiliary supplies with hypo emergency barrel installations, and (e) collect samples of water from private supplies for bacteriological analysis; (4) five mobile laboratories, each in charge of a competent bacteriologist, were sent into the rural sections to analyze the water samples collected by the engineers; and (5) twenty-four hour service was instituted at the Department's main laboratory in Philadelphia. In twenty counties several thousand water supplies had been examined in this manner. In one area, the engineers collected samples from all known supplies within a radius of twenty miles. In one town a 2½-mile pipe was laid on the ground to pump water to a filter plant to augment the almost exhausted supply. The wash water from the filter plant was pumped back to the sedimentation basin. Waste condenser water at a temperature of 125° F, was pumped directly into the distribution system. Pumps were installed on wells long unused, and a pump driven by a tractor was placed on the river bank. These measures prevented any typhoid fever outbreak and resulted in the lowest typhoid fever morbidity for several years in August, the peak of the dry weather period. Of the typhoid cases occurring, none could be attributed to any emergency public water supply.

Drought conditions in Ohio[18] have necessitated curtailment of the use of water for sprinkling, and resort to wells and old mine workings for additional supplies. The village of Caldwell is using a highly polluted water as auxiliary supply; the city of Struthers constructed a 3000 foot pipe line to connect with the mains of a nearby city; and army trucks are being utilized to haul water from the Ohio River supply at Marietta to outlying rural districts.

The drought has affected Maryland water supplies[16] seriously in many cases. At Havre de Grace, the salt content of the Susquehanna River, which is the source of supply, increased from 9 to 582 p.p.m. due to the inflow of brackish water from the upper Chesapeake Bay as the flow of the river diminished. The unpalatability of the water has led many residents to use wells and springs in town. At Annapolis, the use of water was restricted, and auxiliary supplies were obtained from streams and the Naval Academy and an additional well is under construction. At Port Deposit and Brunswick, additional water has been pumped from rivers after heavy chlorination. At other towns the drying up of streams has necessitated the use of individual wells and springs, and the installation of new sources of supply.

Typhoid fever in New York City[17] has decreased from 2,455 cases and 332 deaths in the population of 5¼ millions of 1915 to 500 cases and 64 deaths (.92 per 100,000) in the 6,900,000 population of 1930. Thirty-one per cent of all cases represent non-residents hospitalized in New York City and residents contracting typhoid out of the city. The city cases are due to bathing in polluted waters, contact with carriers, and other causes. The department carries the names and addresses of 255 typhoid fever carriers, all being under regular supervision.

Adequate financing and accounting in water works[15] is of great importance. According to F. W. Schulz, the best and most practical accounting system for a water works should be established, and a competent accountant employed to keep accurate records. These records should show by comparisons the trend of both revenues and expenses. In financing the construction of waterworks, L. M. Anderson suggests: (1) Securing proper legislation to place the management in an independent non-political body divorced entirely from the city government, and to legalize the issuance by the Water Commission of long term bonds paid off at some future date by the issuance of new bonds or cash; (2) establishing rates ample to pay operating expenses, depreciation charges, and bond interest; (3) paying for construction charged to capital accounts out of bond funds; and (4) placing the surplus from operations in a sinking fund for bond redemption when due.

Water rates in a metered system[33] should be simple and practical and provide for depreciation, replacement, operation, interest on bonds, sinking funds for retirement of bonds, and reserve for unexpected expenditures.

In the U. S. in 1800[34] of 16 centralized water works

systems, only 1 was municipally owned or 6¼ per cent. In 1835 this percentage was 28; in 1855, 45; in 1875, 54; and now about 75.

Water diversion rights[29] have many important aspects. No riparian proprietor has a right to use the water of a stream to the prejudice of other proprietors above or below, unless he has a prior right to divert it, or title to some exclusive enjoyment. He may use the water while it flows over his land as an incident thereto, but he cannot unreasonably detain it, or give it another direction, but must return it to its ordinary channel when it leaves his land. Public utilities are intended to operate for the benefit of the public generally, therefore a water company which is legally a public service corporation, may appropriate and use water when, under similar circumstances, a strictly private corporation would not be entitled to this privilege.

An electric thawing machine[27] used by the city of Ottawa, Canada, since 1919 is a self-contained power plant mounted on a truck and generates current of sufficient capacity at the required voltage to thaw pipes from ½″ to 6″ in diameter. With this machine it is not necessary to connect with high voltage or other wires. The first 725 frozen services were thawed out at a cost of $1.78 with this machine as compared to the transformer method cost of $6.05 before 1919.

Water waste in Oklahoma City[26] is reduced considerably by (1) noting the volumes of water delivered to mains, sold, and used for municipal purposes and allowing 5 per cent for meter slippage and 5 per cent for municipal use; (2) inspecting and checking meters and meter accounts to pick out meters which have slowed up in registration and meters which have clocks left without the glass; (3) following this routine—(a) listening for leaks on each fire hydrant during its semi-annual inspection and when it is repaired; (b) listening for leaks on each valve during its annual operation; also when it is operated for shut-outs or repairs; (c) listening for leaks on mains and services; (d) making semi-annual or more frequent inspections of a miscellaneous list of probable leakage sources, such as river crossings, sewer flush valves, mains and service pipes at points known to be rigid in concrete as concrete sewers; (e) making annual inspection of fire lines, both hose and sprinkler types; (f) using the water phone for all outdoor listening except at night when it is quiet, when the geophone is sometimes used.

Closing watersheds in national forests[35] to protect public water supplies drawn therefrom would mean: (1) A loss to logging and milling industries and local business; (2) a loss for grazing purposes; (3) removal of lands for recreationists; (4) a considerable increase in patrol costs; (5) little actual benefit in watershed protection, for in many cases the areas are partly owned by private people; and (6) a loss of revenue to federal and county governments. A desirable policy is to consider each supply individually, weighing the economic factors against the health hazards. In many cases, limited watershed restriction such as closing to picnicking would be sufficient protection, with necessary water purification by works in the city.

The new Cedar Rapids, Iowa, water softening[21] and filtration plant of 12 m.g.d. capacity treats the Cedar River water by aeration, coagulation with lime and alum, clarification and sedimentation, carbonation, and filtration.

The water supply of Canberra,[4] Australia's new capital, consists of a storage reservoir, 3 service reservoirs, pumping station with electrically operated centrifugal pumps, and force and gravity mains.

Gate valves in a water system[30] should be inspected thoroughly and systematically annually to see that they are open and function satisfactorily.

Water was measured[32] according to the earliest record in 1 A.D. The first patent on a water meter was issued on February 5, 1850, in Williamsburg, N. Y. Since then refinements have been made continually, resulting in the meter of today.

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Relation Between County and State of Wisconsin With Reference to Maintenance

By W. Hoenig

Maintenance Engineer, Wisconsin Highway Commission

The state trunk highway system in Wisconsin consists of 10,227 miles. This mileage is divided into three classifications; namely, the primary, secondary, and ordinary state trunk highways. There is allotted from the automobile license fees and gasoline tax for maintenance the sum of $500 per mile for the primary highways; $400 per mile for the secondary highways; and $300 per mile for the ordinary state trunk highways.

Under the law the counties are to maintain the trunk highway system, furnish the necessary equipment, labor and supervision; and when any county shall maintain to the satisfaction of the Commission the trunk highway system within its limits, there shall be paid to the county treasurer out of the state trunk highway appropriation the actual cost of such maintenance, including such allowance for the use of county machinery as shall be agreed upon in advance by the county highway committee and the commission. Such payment shall be made, up to the amount available in the state trunk highway appropriation for maintenance, upon the presentation by the county clerk of a properly itemized and verified account, approved by the commission, to the Secretary of State.

In our issue for October, 1930, under the heading "Rental of Highway Machinery" we made a statement relative to the arrangement made between the counties and the state for highway maintenance which we have been informed was incorrect and at our request Mr. Hoenig has explained what this arrangement actually is. The article referred to was based upon an agreement made between the state and Kewaunee county, which were referred to therein as the "party of the first part" and "party of the second part," which method of designation led to our misunderstanding of the relationship. The rental prices given in the article were those agreed upon for the use of Kewaunee county machinery, but Mr. Hoenig informs us that such rental rates have not been used in these agreements for some time.

Waterproofing the Nashville Reservoir

Our attention has been called to an erroneous statement in the subhead of the article with the above title on page 39 of our December issue. The subhead reads: "Walls of a five-acre reservoir covered with an asphaltic membrane and this in turn with a *ten*-inch layer of gunite concrete." As stated in the body of the article, "Bids were taken on a 10-inch concrete lining—and also on a 3-inch layer of gunite as an alternate" and the latter was adopted. In writing the subhead we apparently read this statement too hurriedly and "slipped a cog."

Contracting in This Machine Age

In a letter recently received from P. J. Ridge, manager of the Bituminous Paving & Resurfacing Co. of Pittsburgh, Pa., he presented an interesting view of one phase of modern contracting. Said he:

"I can not agree with your ideas as to the great prosperity of the contractors the coming year. There has been ample work for the past several years if it had been confined, as it used to be, to mostly manual labor. But since the war the machine age has come and is here, and is encouraged by engineers and public officials. It can have only a very bad effect on labor: you can't replace labor with machines and expect the same labor to exist on air—it requires actual and fairly steady employment for the great mass of labor to exist in tranquility. With the rush methods in force today on all public enterprises by engineers, they are going to drive this nation into a calamity. History will record that today there are too many contractors of no experience, equipped by bonding company agents striving for commissions. Consequently, so many failures. Three to 4-mile road jobs in Pennsylvania having from 25 to 45 bidders, ½-mile jobs, 10 to 25 bidders—this does not look good for future contractors' prosperity.

"After nearly 50 years on general practical experience I can't see it, but hope you are right. Time will prove which is right."

Construction of the Moccasin Dam

(*Continued from page 32*)

width upstream of 3 feet and downstream of 4 feet, with a 1:1 slope upstream and ½:1 downstream. From this fill, both up and down stream, the material was graded from fine to coarse, the upstream slope being 2½:1, and the downstream 2:1 with an eleven-foot berm. The upstream face was finished with hand-placed riprap having a minimum thickness of 12 inches.

A wall of loose rock 8 to 12 inches thick was laid against the downstream face of the core wall for its full depth and length to collect any seepage through the wall, and lead it to an 8-inch tile drain laid on bed rock from the wall to the downstream toe.

The fill totaled 143,341 cu. yds. of which 129,257 (including the riprap) is within the prescribed lines; the balance having been dumped on the downstream face to waste material excavated from the spillway cut and elsewhere after the dam had been completed. The fill was completed in about four months.

The spillway, excavated in bed rock, is designed for a flow of 9,000 sec. ft. with a 5-foot freeboard. Piers were constructed to support four automatic gates, each 18 ft. long by 11 ft. high. The spillway construction contains 2,359 cu. yds. of concrete and 147 tons of reinforcing steel. A road which formerly crossed the reservoir site now crosses on the top of the dam and is carried over the spillway by a concrete bridge. To protect traffic at this point, guard fences and a suitable lighting system were installed.

To afford means of draining the reservoir after the aqueduct is in operation and to pass the flow from the power house in the interim, a circular reinforced concrete tower 10 ft. inside diameter with 8-in. walls and equipped with a 7-ft. by 7-ft. slide gate electrically operated, was constructed, requiring the placing of 94.5 cu. yds. of concrete and 9.38 tons of reinforcing steel.

The flow from the reservoir to the aqueduct tunnel is controlled by two 6 ft. by 8 ft. 6 in. electrically operated slide gates, installed in a reinforced concrete tower, constructed directly over the tunnel portal. Work was begun on the excavation for this tower as soon as concrete operations were completed in the tunnel. A steel truss foot bridge 65 ft. long connect the tower with the shore.

The main tower contains 475 cu. yds. of concrete and 66.07 tons of reinforcing steel.

A canal 380 ft. long, with a bottom width of 20 ft. and side slopes of 1½ to 1, was constructed to lead the water from the reservoir to the main outlet tower. This work required the excavation of 5,000 cu. yds. of rock and earth, which were placed on the downstream slope of the dam outside of the prescribed lines.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

RECENT LEGAL DECISIONS

By John Simpson

MUNICIPAL

Delay in Making Improvement Ordered Held Not Unreasonable

Where several streets are involved in an improvement ordered by an ordinance, the Kentucky Court of Appeals holds, Peters v. Kash, 25 S. W. (2nd) 1025, that no delay will be regarded as unreasonable unless it is made affirmatively to appear that temporary improvements have been made, or that the conditions have so changed as to impose on the abutting property owners a burden which they would not have had to bear if there had been no delay. A resolution of necessity passed in January, 1919 was not considered obsolete although no bids were advertised for until December, 1923.

Contractor Presumed to Know Limited Authority of Municipality

Any person dealing with a municipality, or with municipal authorities such as school trustees, is bound to know their limited authority to enter into contracts involving the expenditure of public funds, and that, for his own protection, he must examine the records and determine for himself whether the proper steps have been taken to enter into a lawful contract. In an action by a building contractor against school trustees and others to recover damages for alleged fraudulent conspiracy in inducing the contractor to enter into a contract for the construction of school buildings when the defendants knew or should have known that the procedure relative thereto was illegal and unauthorized, it was held, Lohrig v. Rochat (Ind. App.) 169 N. E. 77, that the plaintiff could not be heard to say that he was ignorant of the law, and that he was depending on the superior knowledge thereof of the municipal authorities.

Sufficiency of Notice to Pave

Where the work of paving a sidewalk is clearly separable into sections, the West Virginia Supreme Court of Appeals holds, Town of New Martinsville v. Shiben, 151 S. E. 697, that a municipal notice to a lot owner to pave his entire frontage is not void merely because a small section of the frontage is not on the established grade.

Requirement of Advertising for Bids

In a suit by a taxpayer to enjoin the purchase of paving materials without advertisement for bids, the cost of the materials exceeding $500, the Ohio Supreme Court holds, Phillips v. Hume, 122 Ohio St. 11, 170 N. E. 438, that the requirement for advertising provided in section 4328, Ohio General Code, is one of the methods of limitation expressly imposed upon the debt incurring power of Ohio municipalities, when an expenditure exceeds $500; and if the provisions of a city charter are in conflict with a state law upon that method they must yield to the requirements of the state law.

Description of Improvement in Resolution and Ordinance

The resolution and notice required under the Illinois Local Improvement Act need only describe the improvement so as to give property owners a general understanding of what is proposed to be done and the estimated cost, but the ordinance as finally adopted by the city council must prescribe the nature, character and locality of the improvement and so describe it that property owners may know the exact improvement decided upon and that contracts may be let thereunder, and the ordinance is void where it describes three different kinds of improvement and fails to provide in some lawful manner for the determination of the kind to be adopted. Gray v. Black Co., 338 Ill. 488, 170 N. E. 713.

Regulation of Filling Stations

An ordinance prohibiting the construction and operation of a drive-in gasoline filling station within 500 feet of school grounds was held discriminatory and invalid by the Idaho Supreme Court, in Continental Oil Co. v. City of Twin Falls, 286, Pac. 353, because it did not apply to all businesses of the same class. If it was intended to regulate the sale of gasoline as a dangerous or obnoxious business under Idaho C. S. § 3954, its provisions did not cover garages, stores, or other places where gasoline is retailed by means of a curb pump, and the customer does not drive across the sidewalk. If it related to the regulation of driving vehicles across the sidewalk, authorized by C. S. § 3962, it discriminated in favor of those businesses whose patrons drive across the sidewalks to their places of business, such as garages, drive-in refreshment stands, etc. The municipality has the right to classify businesses, but in doing so it may not make an arbitrary distinction between different kinds and classes of business where the conditions are similar.

LIABILITY FOR DAMAGES

Acceptance of Defective Sidewalk by City Absolving Contractor From Liability for Injury

A construction company which had contracted to grade a street by cutting it down approximately 3 feet found it necessary to construct a temporary sidewalk after the removal of the existing sidewalk. It was held, Cummings v. Halpin (Mo. App.) 27 S. W. (2nd) 718, that the contractor was not liable for injuries to a pedestrian by defects in the sidewalk occurring after the city's acceptance of the work. The court said: "It is presumed that, by accepting the work as in full compliance with the terms of the contract, the city made a reasonably careful inspection thereof to discover any defects; and, if the work is accepted in a defective condition, the defects are accepted, as well as the negligence that caused them."

Protection of Roadways by Railings

The Washington Supreme Court, in Davison v. Snohomish County, 270 Pac. 422, an action against a county for injuries to automobilists when their car skidded off the approach to a bridge, said: "It is undoubtedly the law that it is the duty of a municipality to keep its bridges in a reasonably safe condition for travel. On the other hand, a municipality is not an insurer of the safety of every one who uses its thoroughfares; nor is it required to keep the same in such a condition that accidents cannot possibly happen upon them." It was held that negligence of the county was not shown by the fact that the railing on a bridge

approach, by decay of the posts, was insufficient to prevent an automobile from skidding off. Nor was negligence of the county in the maintenance of the bridge approach shown by the fact that the deck sloped toward the outer edge on a curve, tending to cause a car to skid in that direction, or by the fact that dirt was scattered on the deck, causing it to become slippery when wet, there being no evidence that the county had any notice of this condition.

Protection From Concrete Construction on Road

The Maryland Court of Appeals holds, Tri-State Engineering Co. v. Graham, 148 Atl. 439, that, although the mere doing of work necessary in the construction of concrete shoulders on the side of a state road is not negligence, if in the course of such construction the road is thereby rendered dangerous to people passing along and over it, there is a legal obligation on the contractor to safeguard the traveling public from impending danger, either by warning signs or in some other effective manner.

City's Liability for Negligence in Construction and Maintenance of Sewers

In an action against a city for the flooding of a basement by an obstructed sewer, the Alabama Court of Appeals holds, City of Birmingham v. Norwood, 126 So. 616, that in the exercise of its statutory powers to construct and maintain a system of sewers and drains, a municipal corporation acts ministerially, and is liable for damages proximately resulting from negligence in such construction and maintenance. An action for damages for negligence in the construction and maintenance of a drain or sewer cannot be defeated on the ground that it was for the benefit of the public health.

The same court holds, City of Birmingham v. Greer, 126 So. 859, that if city sanitary sewers, during the management of the city and by its authority or with knowledge of the conditions, have become overloaded, and thereby rendered too small for the service required of them, and the city allows this condition to exist after notice, when with reasonable diligence it could have remedied the condition, that would be a negligent maintenance. Following the advice of skilled engineers in planning and executing a general system of sewers would not be justification for the city's failure to exercise due care in executing the plans or maintaining the system after it is built.

ASSESSMENTS

Lack of Statutory Authority for Special Assessment

The Indiana Appellate Court holds, Indiana Asphalt Paving Co. v. Grand Lodge, K. of P., 170 N. E. 85, that a city may have the power to make a public improvement and yet have no power to levy a special assessment against the property benefited to pay the expense of such improvement. An improvement calling for the widening of a street by taking from the sidewalks necessitated the construction of a pavement in front of an abutting owner's lot over an excavation such owner had made for restaurant purposes. To lay this strip of pavement, a substantial substructure for its support became necessary. The owner refused to put in this substructure and the city engineer ordered the successful bidder for the improvement to put it in as an extra under his contract. This was done and an assessment was made against the owner's property as "general assessment" and another for the cost of the work in the basement as "private extra." It was held that the latter assessment was invalid, there being no statutory authority for the levying thereof. The contractor's contention that the owner was estopped to question the validity of the assessment by standing by until the benefits had accrued was not sustained. The court said: "The authorities cited and relied on by appellant [the contractor] are cases where there was a law purporting to authorize the proceeding complained of, a law afterwards held unconstitutional or which was later held to be repealed by implication; or a law susceptible of two or more constructions, one of which would authorize the acts of the municipality. That is not this case; there is here no law purporting to authorize the city to order the building of the substructure and the repairs and changes in the basement, *and assess the cost thereof against the property of the appellee* [the owner]. Where a contractor, under semblance of law, proceeds with the work, he acts in good faith, and the principle of estoppel applies [as against an abutting owner]; not so where there is no law. In such a case there can be no estoppel. The contractor is presumed to know the law; to know that there is no law if that should be the fact. With such knowledge, it will not be presumed that in taking the contract and making the improvement he acted in good faith."

Rule as to Assessment for Public Improvements

If public improvements are primarily and essentially for the benefit of the abutting property, the entire costs, not to exceed benefits to abutting property, may, the Florida Supreme Court holds, Smith Bros. v. Williams, 126 So. 367, be assessed and properly apportioned against the abutting property. If they are primarily and essentially for the benefit of the public, the entire cost of the improvements may not legally be assessed against the abutting property; and if the road improvements are for the benefit of the public and of the abutting property, the cost should be properly apportioned between the public and the abutting owners and also among the abutting owners.

Assessment for Cost of Paving Street Intersections

The Louisiana Supreme Court holds, New Orleans & N. E. R. R. v. City of New Orleans, 169 La. 1103, 126 So. 673, that the area on each side of an avenue, paved by a railroad company under contract with the city as consideration for the privilege of laying its tracks across the avenue, is not exempt from assessment of its proportionate share of half the cost of paving the intersections, under Laws 1924, No. 191, as not fronting on the avenue. The statute authorizing such assessment is not unconstitutional as class legislation or as lacking uniformity. A street-paving assessment according to the front foot rule is not unconstitutional as taking property without due process of law.

Procedure in Appeal From Paving Assessment

In an action by a contractor to recover the amount of an assessment for street work, it was held, Gallagher v. Voyce, (Cal. App.) 279 Pac. 490, that, since the street work was done under an ordinance providing that the board of public works would make the assessment, and that if the assessment was claimed to be incorrect or illegal a property owner might within 30 days appeal to the board of supervisors, a property owner whose property was assessed for the improvement was not entitled to attack the assessment where he appealed, but did not prosecute his appeal, and the appeal was denied.

Aeration as an Auxiliary to Trickling Filter Treatment

(*Continued from page 20*)

application so that the net result in the filter effluent should be at least equal to the combined processes during the day.

The paddle wheel shaft completes 50 revolutions per minute. Figured on the basis of the sewage displacement from the trough and the theoretical detention period, the total sewage flow is circulated through the tank and subjected to aeration across the surface four times in its passage through the tank, at full plant capacity.

This requires 1/30 of a theoretical H. P. for operation. In this particular case the loss of energy in shaft-bearing friction and motor losses is several times that actually consumed in displacing the sewage from the trough.

Operation Results

While the plant has not been in operation a sufficient length of time to gather complete analytical data, sufficient analyses have been run to indicate the trend of purification through the plant and the effectiveness of the partial aeration device as an auxiliary device in the treatment of settled sewage.

Table 1 and figure 5 show the comparative condition of the sewage before and after passing through each plant unit. The analyses presented in this table are averages of all those run to date and are not intended to represent other than a preliminary report on the trend of purification through the plant. It may also be stated here that, while the values of individual runs differ, the trend is always the same as shown by about the same magnitude in percentage.

The comparatively big increase in B. O. D. of the primary settling tank effluent is due to septicity of the sewage created by the long detention period at the present rate of flow. The theoretical detention period at full plant capacity is 2 hours. The present rate of flow causes a detention period of between 6 and 7 hours.

The effect of this long detention period is also shown in the comparatively large increase in turbidity and free ammonia through the unit. The turbidity increase is attributed to the disintegration of suspended material into more finely divided particles. The ammonia increase indicates the decomposition of nitrogenous material under prolonged anaerobic conditions. The drop in pH is also consistent with the prolonged detention.

The increase in B. O. D. through the primary settling tank is representative of the effect of conditions occurring at institutional plants which are designed for the future maximum population; the initial population is usually quite small and for a period of several years the plant is over-capacity. This might be avoided by designing the plant for a shorter future period with the idea of duplication of units when needed by the increased flow. The objection to such a procedure is that, with the comparatively small size of the plant, the cost of duplicate tanks per unit of sewage flow is nearly double that of one tank to care for the same flow.

Table I—Plant Operation Results at Annandale, N. J.

Location	B. O. D. 5 day	Solids		Turbidity	NH_3-N	NO_2-N	NO_3-N	B. coli presumptive	Bacteria 37½° count	pH
		Susp.	Settleable							
	p.p.m.	p.p.m.	c. c. per liter	p.p.m.	p.p.m.	p.p.m.	p.p.m.		per c. c.	
Raw sewage	137	..	13.6	18	3	0	0	232,000	130,000	7.1
Primary settling tank effluent	214	47	0.7	55	47	0	0	50,200	140,000	6.7
Aerator effluent	126	75	1.2	47	28	0	0	57,000	265,000	7.3
Trickling filter effluent	35	36	..	43	23	3.2	8.25	5,000	75,000	7.8
Plant effluent (chlorinated)	37	27	..	42	20	0.65	4.60	18	20	7.1

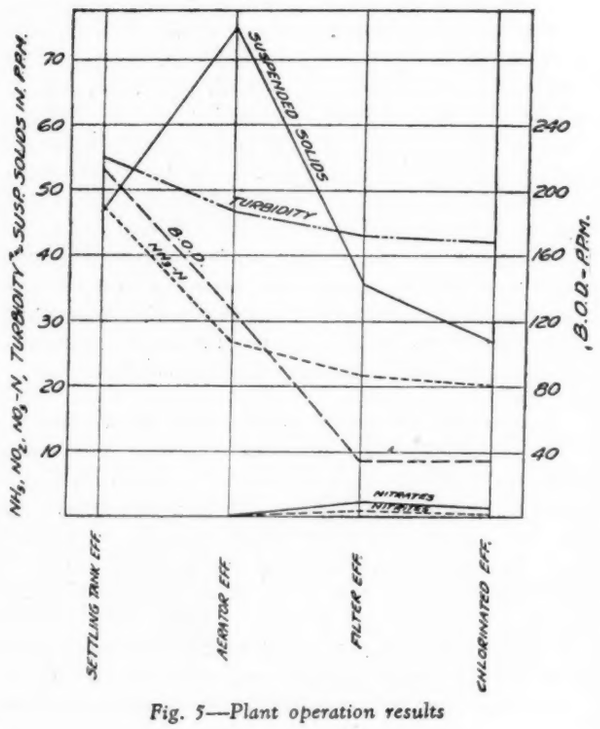


Fig. 5—Plant operation results

The unusually large settleable solids contents in the raw sewage is due to grease, kitchen and sink wastes, and sand. The solid materials including kitchen wastes appear to reach the plant in a less dispersed form than in municipal sewage. This is due to the freshness of the sewage and the short distance of travel from the institution. Generally the greasy matter reaches the plant in precipitated form. The sand and gritty matter result very largely from the habit of the inmates in washing their shoes in the building after coming in from work in the fields and on the grounds. The receiving drains connect to the sewer.

The influence of the various units on the hydrogen ion concentration of the sewage in its passage through the plant is pointed out as showing the quick effect of septic conditions in the primary settling tank which causes a decrease in the pH, and the effect of aerobic conditions with resulting increase in pH caused by the combined factors of driving off a part of the CO_2 content and the natural results of oxidation of organic material under the aerobic conditions.

The net effect of the aerator is definitely shown in the table by the average reduction in B. O. D. of 41

per cent. This figure varies in individual runs between 33 and 51 per cent.

No nitrites or nitrates are found in any part of the aerator, even though the NH_3-N reduction amounts to 33-40 per cent. This is presumably due to the fact that either the organic material oxidized is not nitrogenous in character, or, if nitrogenous, the oxidation has not proceeded sufficiently far to allow the formation of those products.

What becomes of the NH_3-N seems to be a matter of conjecture. The loss may be attributed to one or a combination of the four following factors: (1) Direct oxidation, giving elementary nitrogen and water; (2) oxidation to nitrites and nitrates; (3) protein synthesis of bacterial cell protoplasm; and (4) mechanical release from the sewage into the air by the aeration process.

Oxidation to nitrites or nitrates has not been observed in this instance. Synthesis into cell substance is presumed to be small. Recent experiments in this laboratory, yet unpublished, as well as findings by other investigators, show that the mechanical release of ammonia into the air is not equal to the amount lost from the sewage. This leaves direct oxidation to elementary nitrogen, to which many attribute the loss, for lack of other explanation. This theory, however, has also been discredited by some investigators.

The increased suspended and settleable solids and decreased turbidity through the aerator show that a certain amount of flocculation of finely divided material is produced.

While not mentioned in the tabulation, the dissolved oxygen content ranges from 0.5 to 1.0 p.p.m. in all sections of the aerator.

Aerator Results

The comparative analyses of the aerator influent and effluent were shown in figure 5 and table 1. These, however, were on a basis of approximately a nine-hour detention period with the present quantity of sewage flow. If the efficiency through the aerator is proportional to the time of detention, the accomplishment of the aerator at full plant capacity, with a detention period of only 3½ hours, would be insufficient to materially assist subsequent oxidation devices.

To determine what might be expected of the aerator on shorter detention periods, samples were taken at consecutive points in the aerator representing various time intervals. The results, shown in figure 6 and table 2, represent an individual run. Other runs show a similar trend with about the same percentage changes.

Practically the entire B. O. D. reduction observed occurs in 3¾ hours. Additional aeration beyond that time (up to at least 9 hours) appears to be of little value for materially greater reduction in oxygen demand of the more resistant material, without the aid of more intensive biological activities such as would be induced by mixing with activated sludge. In this case the filters following the aerator handle the more resistant material and substitute for the activated sludge floc activities.

Table II—Progressive Condition of the Sewage Through the Aerator

Location Bay No.	Detention hours	B. O. D. 5-day	NH_3-N p.p.m.	Bacteria 37½° Count per c.c.	B. coli per c.c.	pH
Influent No. 1	0	350	60	140,000	45,000	6.7
Influent No. 2	1.25	295	60	94,000	40,000	7.3
Influent No. 3	2.5	240	50	130,000	70,000	7.3
Influent No. 4	3.75	180	40	150,000	70,000	7.3
Influent No. 5	5.0	180	35	180,000	10,000	7.3
Influent No. 6	6.25	170	40	210,000	40,000	7.3
No. 8—Effluent	8.75	190	35	265,000	40,000	7.3

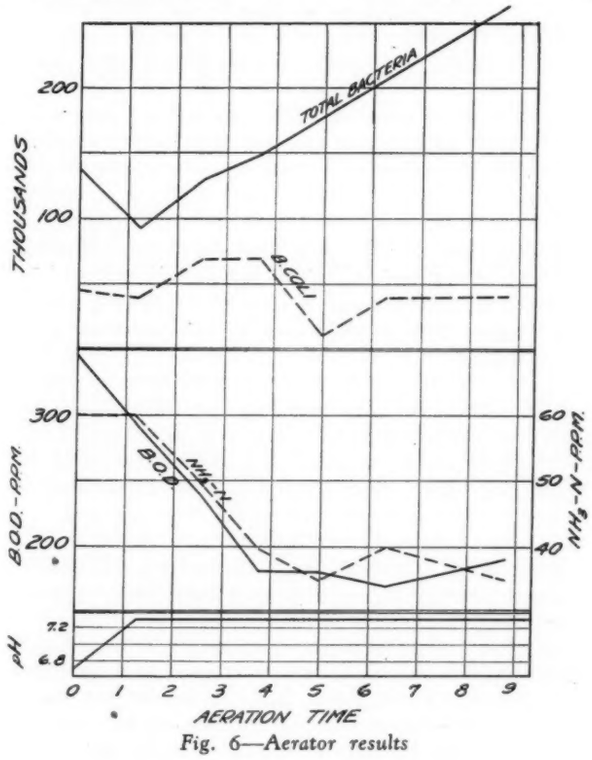


Fig. 6—Aerator results

The maximum reduction in free ammonia occurs in approximately the same time as the maximum B.O.D. reduction. Any additional period of aeration up to at least 9 hours seems to be of no value from the standpoint of ammonia reduction. A very close parallel trend of NH-N and B.O.D. is shown.

Total bacteria (24 hour, 37½°C. count), after a decrease during the earliest stages of aeration, increase rapidly up to the end of 9 hours, where apparently the maximum has not yet been reached under the aerator conditions. The initial decrease followed by a subsequent increase is presumably due to the death of those forms of organisms which have developed under the septic, anaerobic conditions of the primary settling tank, followed by the development of aerobic forms common to conditions of aeration. Another theory presented by observers on this subject is that the agitation by air or mechanical means may break up suspended particles of the organic material and clumps of bacteria into greater individual numbers. However, in this case coagulation of material, occurs rather than dispersion, as indicated by the increase in suspended solids.

The B. coli counts (presumptive test) through the

aerator are fairly constant with no consistent reduction. Very often on individual runs the numbers in the aerator effluent are 100 per cent or more greater than in the influent. At other times the reverse trend occurs. This might be attributed to the fluctuation of numbers of B. coli in the raw sewage, caused by intermittent discharge of fecal matter in great quantities at definite periods during the day when the inmates come to the buildings at the same time. The sewage containing these excess discharges would theoretically occupy a definite position in the aerator corresponding to the time of discharge and might cause the fluctuations in numbers shown in the results.

Heukelekian and Rudolfs (1) have shown in laboratory experiments, however, that the B. coli counts are very erratic during a continuous period of aeration of settled sewage. They also show that an increase in B. coli may be expected during the initial stages of aeration. Both of these observations conform closely to those found in this case at different times.

Remarks

It is not the intention to derive, from the results on this installation, conclusions meant to be applicable to sewage in general, until further studies on the aerator indicate whether there are any pecularities in this institutional sewage or plant that might cause the favorable results shown.

However, the following indications are apparent:

It appears that the value of the aerator lies chiefly in partial reduction of bio-chemical oxygen demand and flocculation of a part of the colloidal material previous to application on the trickling filter.

The aerator does not reduce the numbers of organisms of the colon group.

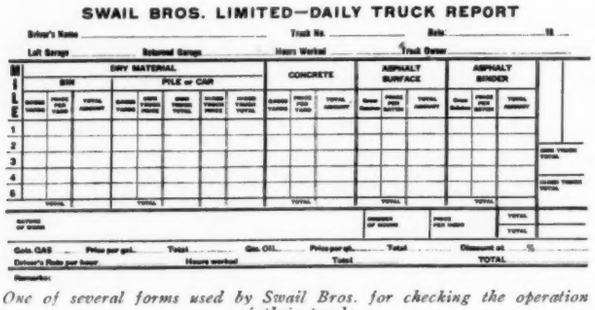
Under conditions where a septic sewage is to be handled, the aerator offers a flexible method of relieving an excess load on the following purification devices.

While it cannot be definitely stated, due to lack of evidence from practical application in this case, it might also appear that the aerator would be of value in cases of fresh sewage where the final purification processes were overloaded.

Ready-Mixed Concrete Delivered by Contract for City of Winnipeg

(*Continued from page 22*)

other to the foreman on the job, and the third to Swail Brothers. The truck drivers return daily reports detailing the work done by their trucks. All cost, hauling, and operating data are recapitulated on monthly sheets. From figures on these sheets, the cost of operating each truck and the amount it is earning are figured.


SWAIL BROS. LIMITED—DAILY TRUCK REPORT

Driver's Name ____ Truck No. ____ Date ____ 19__

Left Garage ____ Returned Garage ____ Hours Worked ____ Truck Owner ____

TRUCK	DRY MATERIAL							CONCRETE			ASPHALT SURFACE			ASPHALT BINDER			
	SAND			PILE or CAR													
	Number Yards	Price per Yard	Total Amount	Number Yards	Open Top Price	Open Top Total	Closed Top Price	Closed Top Total	Number Yards	Price per Yard	Total Amount	Gross Tons	Price per Ton	Total Amount	Gross Tons	Price per Ton	Total Amount	
1																	
2																	
3																	
4																	
5																	
	TOTAL			TOTAL					TOTAL			TOTAL			TOTAL			

NATURE OF WORK			NUMBER OF HOURS	PRICE PER HOUR	TOTAL
					TOTAL

Gals. GAS ... Price per gal. ... Total ... Gal. OIL ... Price per gl. ... Total ... Discount at ... % ...

Driver's Rate per hour ... Hours worked ... Total ... TOTAL

Remarks:

One of several forms used by Swail Bros. for checking the operation of their trucks

(1) Heukelekian and Rudolfs, Sewage Works Journal 1, 561-567, 1929.

Careful check of each motor truck each night is made by a special mechanic employed for the purpose. This man makes necessary adjustments and minor repairs and greases the trucks. This nightly check of the trucks is considered very important by Swail Brothers, and has enabled them to carry out their part of the contract with the city without a hitch. In case of mechanical difficulties while a truck is in operation, a day service man is available to rectify the trouble. Even in case of tire work, the service man is called upon to make the changes.

Swail Brothers' bid for this hauling contract was, for concrete, 40 cents per yard for the first mile, 75 cents for two miles, $1.05 for three and $1.10 for four; and for gravel and crushed stone 28 cents for the first mile, and 40 cents, 50 cents and 60 cents for two, three and four miles, respectively. For hauling asphalt surface and binder the prices per box of surface (1690 lbs.) and per box of binder (1010 lbs.) were as follows: First mile, 24 cts. for surface and 14 cts. for binder; two miles, 28 cts. for surface and 18 cts. for binder; three miles, 34 cts. for surface and 24 cts. for binder; four miles, 38 cts. for surface and 28 cts. for binder.

Tunneling a Highway Under Newcastle, Calif.

(*Continued from page 25*)

railroad tracks being concrete and the balance being redwood timber lined, heavy and light types.

An electric lighting system is to be installed.

The actual cost of the tunnel itself, including boring, lining, concrete portals, lighting, and contingencies, is $121,500, or approximately $230 per lineal foot. The total estimated cost of the project now under contract, 1.17 miles in length, is approximately $225,000.

Work started on this project on September 2, 1930, and the date for completion is May 27, 1931.

The T. M. Morgan Paving Company is the contractor; C. H. Whitmore is district engineer, and J. W. Trask is resident engineer in immediate charge of the work under C. Cleman, district construction engineer.

For the above facts and the illustrations we are indebted to "California Highways and Public Works," the official journal of the State Department of Public Works.

Chlorination of Sewage and Sewage Effluents

(*Continued from page 29*)

of less than fifteen acres is from $65 to $100; for 15 to 25 acres, $45 to $65; and for 25 acres or over, $25 to $45.

Cost for Reducing B. O. D. On the basis of applying 70 to 100 lbs. per m.g. during 120 days of the year, the cost for plants of less than 1½ m.g.d. would be $5.50 to $8.50; those of 1½ to 3 m.g.d., $3.75 to $5.50; and those more than 3 m.g.d., from $2.25 to $3.75.

Conclusions

Present-day practice demonstrates that chlorination has a definite place in sewage treatment. In recent years the development in this field has been extremely rapid. This same experience occurred in the field of water purification. It should be emphasized, therefore, that chlorination is not a cure-all for all the ills in sewage treatment and, as in the case of water purification, it must be regarded as a valuable adjunct to and not as a replacement for recognized methods and processes of treatment.

Training Operators for Filtration Plants In Small Towns

By A. E. Clark

Associate Sanitary Engineer, Tennessee State Dept. of Public Health

THE last few years have seen the development of an increasingly large number of water supplies for small towns. This has been due in part to the tendency, particularly since the World War, for industries to move from the larger cities to the smaller towns; many of which industries require guarantees of an adequate supply of water, and some of them of specified quality also. Moreover, citizens of the smaller towns are now demanding public water supplies.

Many of these small-town supplies require treatment for removing iron, hardness, turbidity, color, bacteria or algae, which necessitates a plant especially designed for the purpose, and this in turn requires intelligent operation if it is to function properly. The larger towns and cities are able to employ a technically trained and experienced operator for this purpose, but the smaller towns can not often afford the employment of such a man.

A division of sanitary engineering is an integral part of virtually every state department of health in the United States, and one of the most important functions of such a division is the supervision of public water supplies. The operation of the smaller purification plants constitutes a problem for them as well as for the town itself. The laws and regulations adopted by the health departments confer on them certain police powers by means of which proper operation can be enforced, but this method does not produce the best or most efficient operation. A stimulation of interest on the part of the city officials and the operator himself, along with help and cooperation from the health department, make a combination which works to the mutual advantage of all concerned.

The best method by which the health department can help the operator has been the subject of considerable thought and study. The personnel of most divisions of sanitary engineering is limited, as well as their funds. The training of the small-plant operator has been in most instances a matter of individual training by an engineer from the health department. Obviously, with a small force of engineers, combined with the many other duties incumbent on the engineering division, a relatively small amount of time can be given to the individual operator, particularly in those states having perhaps more than 150 public water supplies, of which at least one quarter to one third have purification plants and another third have equipment for disinfection.

The general establishment of engineering divisions has occurred during the past ten or twelve years, so that, in the majority of states, progress in the training of operators has been rather slow. A certain amount of ground work is necessary for the supervision of public water supplies, such as familiarity with all the plants, the types of water being treated, and the attitude of the officials and operators in regard to operation. While acquiring this a certain amount of training can be done, but there is a question regarding the ultimate benefits of individual training carried out in this way, as against group training at some central point where every facility is at hand to demonstrate the principles of operation as well as laboratory technique.

Some years ago two health departments started with the idea of group training. One began the work by holding yearly conferences on water purification, the other by holding a short school at which lectures and laboratory work were given. Since then a number of states have taken up the idea, each operating according to the individual ideas of the benefits to be derived from various sorts of training. At the present time the different methods can be classified as follows: 1—Conference; 2—Conference and Short School; 3—Short School. The relative merits of each depend on a number of factors, probably the most important of which is the length of time the engineering division has been functioning and the method of supervision adopted. In those few states in which an engineering division has been functioning over a rather long period of time and in which certain laws have been enacted and enforced regarding public water supplies, the conference may work to the best advantage. In another group of states with a shorter period of time since establishment of the engineering division and fewer laws, the conference-school idea might seem best. In those states which have been working for the shortest period of time and without the backing of stringent laws, the school idea appears to have the most merit. Briefly, the kind of training best suited to the needs of any particular group of operators depends upon well defined factors.

The Conference

Strictly speaking, the conference is not comparable to the other two methods of training because it is no doubt best adapted to those states having a predominance of technically trained operators. In this case it more nearly resembles the purification sections of the conventions of the national water works associations and to a lesser extent the various section meetings of these associations. It is true that the subjects at the conferences are confined to problems of water purification, but these subjects are of such a nature and the discussions so technical that the non-technical operator of the small plants would be unable to gain much except, possibly, from the contacts with the more highly trained men. For stimulation of trained men it is an excellent method, particularly if special studies are made during the time intervening between meetings and a report or paper on these studies given at the succeeding meeting.

It is difficult at times to overcome the prejudice of many city officials against attendance at conventions and conferences, due to their ideas that little good is accomplished and the real purpose of going is to have a good time. That may have been true a number of years ago, but now the majority who attend conventions and conferences are more serious and expect to gain something. This is true for the con-

(*Continued on page 69*)

Abstracts of Papers at the A. R. B. A. Convention

(Continued from page 35)

2. It is questionable whether either water or sewer connections should be carried to the curb; many spurs may never be used and the caps may leak water.
3. Permits to open streets should be issued only for a block at a time. Blanket permits for long periods should not be issued.
4. Responsibility for future settlements should be placed definitely, at the issuance of the original permit if possible.
5. Emergency permits should be immediately followed by regular permits.
6. A temporary pavement should be immediately required at all cuts in paved streets.
7. That a healthy growth of any city prohibits a restriction against opening streets for connections.
8. Very little attention is paid to reinforcing, battering or dowelling new cuts to the old pavements, nor is cutting back to gain support beyond the edges generally practiced.
9. With stone, asphalt and brick blocks, old blocks are used, together with new ones, in repairing cuts.
10. In cement concrete pavements, a wet mix is general. Very little use is made of an accelerator or quick hardening cement. In this respect traffic resumption is unduly delayed.
11. Concrete base under bituminous pavements is seldom used with either accelerators or quick hardening cements.
12. No emulsion mixes are reported.
13. About 50% use cold bituminous wearing surfaces for patching cuts.
14. Cuts in blanket coats are generally restored with the same base and top materials.

Street Cleaning

Presented by* J. P. BROOME, *City Supervisor, Summit, New Jersey, Chairman.

1. Machine brooming is a dirty, offensive method of street cleaning and should be supplanted with motor pick-up sweepers.
2. Hand flushing is a slow, expensive, economic waste.
3. Motor flushing, at night, followed by pick-up sweepers or hand brooming in the gutters, is most successful.
4. Vacuum cleaning should be the most efficient, but to date is not very practical.
5. The above methods are too severe for new penetration macadam and other lower types.
6. Most cities are lacking in proper equipment for cleaning catch basins.
7. All catch basin openings should be so constructed as to admit of a later use of grab bucket removal of deposits.
8. Drag cable and bucket removal of deposits in drains gives surprising results as to quantity of material accumulating in such drains.
9. That if a gasoline tax is in effect the increased use of vehicles in the winter as a result of snow removal would probably pay for the removal of the snow through gas tax revenue.
10. For real effectiveness, the caterpillar type tractor snow plow seems most efficient, but there is a question, where all year round service is concerned, whether the 4-wheel drive truck with heavy snow plough equipment is not the most economical investment.
11. More information is neded about chemical snow and ice removal.
12. A really successful machine is needed to cut down ice traffic ridges.

Resurfacing and Salvaging of Existing Pavements

Presented by* VERNON N. TAGGETT, *City Engineer, Niles, Michigan, Chairman.

1. Recommendations for one section of the country would be inapplicable in another.
2. Standards can be worked out for certain sections with similar traffic and climatic conditions.
3. No salvaging is indicated in the case of asphalt blocks. More economical and proper workmanship can produce nearly as good a job of old blocks relaid without recutting. Certainly a more durable job is accomplished.
4. More economical results can be obtained by a substantial bituminous covering over old block pavements than to recut and relay them.
5. The same substantial bituminous covering is most economically advantageous to all the other types mentioned.
6. Sprayed applications are not advantageous on granite block pavements.
7. For appearance alone, brick pavements should be patched with brick.
8. Old brick, if removed, has little or no salvage value.
9. It is unwise to attempt to cover old concrete with any but a deep reinforced resurfacing top if cement concrete is employed.
10. The most satisfactory results, in top coating any of the types mentioned in this paper, can be obtained by the use of sheet asphalt on a binder course.
11. Blanket coats can be very successfuly maintained with renewal blankets.

Unpaved Streets

Presented by* WALTER A. HEINBUECHER, *City Engineer, University City, Mo., Chairman.

1. Cold application tar blankets on gravel give better results than either cold or hot oil blankets.
2. Calcium chloride gives good results on earth roads but some complaints are offered that in wet weather the under sides of automobiles are rusted and even brake linings frozen to brake drums over night.
3. No road, of this type, can exist under present day motor traffic, without unlimited care in dragging, unless surface treated with some of the coatings mentioned in this paper.
4. Weed exterminators are in little use in connection with this class of roads.
5. Tar or oil blankets will usually remove the necessity for weed killers.
6. A road roller, following any of the road maintenance operations in this class, is of prime importance.
7. Excessive crowning of unpaved streets, in these days of high speed motor traffic, is a dangerous proceeding.
8. Paved gutters or shoulders are only a necessity on steep grades.
9. Scarifying is usually resorted to in case of macadam maintenance repairs.
10. Any properly constructed gravel road is a potential base for all ordinary types of roadway, up to and including concrete.
11. More benefit can be obtained and more area substantially covered for less money, if the material can be obtained locally, with gravel, than from any other type of roadway material.

Location of Bridges and Culverts

Chairman,* B. P. HARRISON, *Associate Highway Engineer, U. S. Bureau of Public Roads.

Locations are often chosen unwisely because of a desire to utilize an old bridge, either with a view to economy or because of historic associations. An instance was cited where a road, on reaching a stream, turned up it for almost a mile, crossed, and returned on the other side, lengthening the route by 1.7 miles and crossing 17 culverts although saving about 14,000 cu. yds. of fill. In 1927 a traffic census showed 357 vehicles per day passing this point. The road has now been carried straight across and the new location is estimated to save automobilists more than $17,000 a year.

Bridges are too often set at an angle with the highway to avoid making a skew bridge. The bridge should be set so as to give good alignment to the high-

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way, of which it forms a part, even though it may make an angle with the stream as great as 60°; although anything over 45° is objectionable. The skew should be kept as small as is possible without sacrificing alignment. It is sometimes possible and cheaper to change the direction of the channel of the stream rather than of the bridge.

If funds do not permit building a new bridge to replace an old, improperly located one, it is recommended that a new road location and bridge site be laid out, but paving be laid on the new route only so far as it can be used in crossing the old bridge, so that no new pavement need be abandoned when the new bridge is built.

In the case of culverts, the head walls should be set beyond the edges of the earth shoulders, giving a width between them greater than that of the graded roadbed. For structures under fifty feet span on curves, the distance between head walls should be not less than thirty feet.

Approaches to a bridge are, in many cases, given too little consideration. They are especially important where line or grade is not continuous across the bridge.

Maintenance of Traffic Bound Roads

By* H. G. SOURS, *County Engineer, Summit County, Ohio.

This report is in the form of an outline covering the various phases of traffic bound maintenance. It is assumed that the grading and drainage have been properly taken care of.

1. Size and Quantity of Materials—First application may be up to 1½" although usually from 1" down. Subsequent applications should pass ¾" screen.

From 1,000 to 1,500 cu. yds. per mile should be used on first application, bladed in windrows along the sides.

Subsequent applications should be light so as to maintain a small single windrow bladed alternately from side to side.

2. Use of Local Low Cost Materials—Bank run gravel, sand clay, shale, etc., may often be used at considerable saving in cost, especially for first application.

Pea gravel makes an excellent mulch material for surface maintenance.

3. Blading and Dragging Equipment—One man grader or tractor blade combination for heavy blading.

Multiple blade drag is preferable for smoothing and leveling loose surface material.

4. Blading and Dragging Operations—On newly surfaced road the grader is used to best advantage in bringing material from windrows and in shaping the surface.

Also whenever the surface becomes rough and requires cutting to smooth it, especially in the fall and spring and after rains during summer.

The multiple blade drag is best fitted for keeping the road smooth but must have loose material to carry in front of the blades.

5. Crowns—Low crowns in dry weather to be bladed somewhat higher before winter.

6. Seasonal Maintenance—In summer keep surface material thin as possible; it makes easier driving and provides less material to grind up and dust off.

In spring and late fall carry heavy layer of loose material; this is the time to work in the material and build up thickness of metal. Placing material in mud will do no harm.

7. Dust Prevention—Use of calcium chloride is desirable until such time as the road is built up to a point when it is ready to treat with bituminous material.

It prevents dusting, loss of material and assists in maintaining a smooth surface with less blading; it also speeds up the compacting of the surface.

Bituminous treatments and mixed in place tops forming a more or less permanent surface should be used after sufficient base has been built up to resist breaking through. This type of surface provides excellent riding qualities and eliminates blading maintenance.

Grade Crossing Elimination

Chairman*, H. O. SCHERMERHORN, *Engineer of Bridges and Grade Crossings New York State Highway Dept.

In this paper Mr. Schermerhorn stresses the economic side of grade crossing elimination, espcially as developed in New York practice.

Both highway authorities and the railroad are vitally interested and must cooperate in the solution of the problem. The procedure varies in the different states.

In New York the Public Service Commission has quasi-judicial powers, and the railroad company, the State Department of Public Works and municipal representatives appear before it to decide upon the ways and means of solving each elimination. Based on their presentations, the commission issues an order citing the manner and by whom the work is to be done and the division of expenses.

The State has the proceeds of a $300,000,000 bond issue, from which it pays 49% of the cost of the project, the county in which the crossing is located pays 1% and the railroad company 50%; the company being permitted to borrow from the state funds to pay its share if it desires. In some states the division of cost is decided by conference between the interested parties; but the author believes that a fixed percentage for all cases is best.

Five years of intensive elimination activity in New York prove that no plan should be authorized which does not receive the approval of both railroad corporation and state highway department, or which provides for any alignment, grade or width of structure which produces a liability not present upon the highway. All designs and construction for grade crossing eliminations should be approved and supervised by competent highway engineers.

In New York all elimination construction is supervised by the engineers of the Department of Public Works. In general the railroad company awards the contract.

Mr. Schermerhorn believes that, in general, a 5% grade is the maximum that should be used in connection with elimination structures; and where the country is exceedingly flat, a 4% limit is desirable.

In constructing bridges across streams, railroads or other highways, New York fixes 800 ft. as minimum radius for curves and will go to considerable expense to keep it above 1,000 ft.

Center piers in the highway often are desired by railroads but should be prohibited except where absolutely necessary.

Drainage of an underpass is often a difficult problem. If the railroad can not praticably be raised sufficient to allow gravity drainage, a sump and automatic pumping equipment are probably necessary. But failure to function may produce serious condi-

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tions, and the life of the equipment is limited. If, however, satisfactory automatic pumping equipment can be provided, in many instances a saving can be made of large sums otherwise required for elevating the railroad track.

For draining a subway, at least six water inlets should be provided, one at each wing-wall end and one in the center of the abutment, on each side; because of the seriousness of the stoppage of one by leaves, newspapers or other objects.

In general, carrying the highway under the tracks gives a more pleasing construction than carrying it over them, and the latter causes a mental hazard. New York requires a 14 ft. clearance under bridges, allowing 13 ft. where an alternate route closely adjacent, with improved surface, furnishes 14 ft. or more. Modern double-deck bus lines require 14 ft. and are rapidly spreading to all main highways.

A structure on a through route should be designed for four traffic lanes if two lanes are not sufficient—never for three lanes, except possibly near cities where traffic is twice or more as great in one direction as in another at morning and night.

Provision for the future maintenance of the elimination project, as between the railroad and the state, county or municipality, should form part of the original plan and agreement.

The aesthetic point of view should be considered in designing the structure, especially in urban localities, but not at the expense of safety, convenience or other use features. In general, bold, rigid frames are not in place in a flat country, but flat arches or girders are preferable.

In acquiring land for a project, New York has found it better for the State to obtain it rather than the railroad; it is at once available for the award of a contract, which is only true when the state acquired it, and the cost has been considerably less, and also the opposition, than when the railroad did the buying.

In selecting from the many grade crossings, those to receive immediate attention, New York assigns to each an index number, obtained by multiplying the number of trains passing the crossing in 24 hours by the number of vehicles doing so, and arranges the crossings in the order of these numbers. It also considers additional factors, such as the number of crossings on an operating division of the railroad or the highway, so as not to cause too much inconvenience and disturbance of traffic.

Where elimination is impracticable, automatic flashing signals should be provided. At railroads they are much more effective than the use of gates.

There can be no standardization of grade crossing design (of hundreds built in New York state no two have been exactly alike), beyond the setting of limits to grades, alignment and sight distance.

Highway Location

General Chairman, **R. Getty Browning**, *Principal Locating and Claim Engineer, North Carolina Highway Commission*

Classification of Highways

Chairman, **H. D. Palmore**, *State Highway Engineer of Kentucky*

DENSITY of traffic and character of vehicles are two of the most important factors entering into the classification of highways. Two standards approved by the American Association of State Highway Officials during the year 1930 are as follows:

1. The minimum width of the graded section of unpaved roadways shall be 24 feet and this minimum width shall be increased to 34 feet when the traffic exceeds 500 vehicles per day.

2. It is essential that the States, or proper authorities thereunder, establish ultimate right-of-way lines which shall be the limits of all future developments of adjacent property, the width so established to be not less than 80 feet, or more, as the type of road and roadside development may demand. It is understood that the establishment of these lines is in the category of zoning laws under the police power, which does not legally constitute damage, and that when the land is actually taken for highway purposes, the damage may be then legally determined and paid for. (The minimum right-of-way width adopted by many States is considerably less than that adopted by the Association).

In the classification of State highways the following is suggested for discussion, revision and adoption as revised:

Suggested Classification of Highways

Class of Highway	Width Fills*	Width Cuts†	Minimum Surface	Maximum Grade	Maximum Curve	Minimum Width R. of W.**	Minimum Length Pipe Culvert	Minimum Length Box Culvert	Minimum Clear Roadway Bridges	Vehicles per Day
"A"	36′	42′	20′	6%	10°	80′	38′	38′	24′	1000 to 5000
"B"	30′	36′	20′	6%	12°	70′	32′	32′	24′	500 to 1000
"C"	24′	30′	18′	8%	20°	60′	26′	26′	20′	Less than 500
Super Highways or Boulevards	Width of Right of Way, number of traffic lanes, grade, alignment, etc., to be determined for each individual project, taking into account present actual and future anticipated requirements.									5000 & up

*Shoulder to Shoulder.
†Ditch to Ditch.
**Increase minimum right of way width by 20′ for each class at a point 3 to 5 miles from the corporate limit when approaching cities of more than 30,000 population, and 5 to 7 miles from corporate limit of cities of more than 100,000 population.

Super-Highways or Boulevards.—Near the largest cities we find highways carrying up to 50,000 vehicles a day. These should have no railroad or highway grade crossings, draw bridges, or anything which would interrupt the flow of traffic at any time. Vehicles should enter and leave the road in the direction of traffic.

Class A—Those next to super-highways in importance as a traffic route, generally connecting large centers of population. Probably of greater than ordinary width and require more than normal expenditure for grading, alignment and intersections. They may have grade intersections, but pavement should be widened approaching them.

Class B—The same as Class A, but connecting smaller cities to each other and to larger cities. The larger percentage of the highways of a state highway system come under this classification.

The American Association has adopted the following standard of practice for general road design, which appears to be very closely related to classification:

"Standard of practice for general road design; (a) roads having an average daily present traffic in excess of 4,000 vehicles shall be designed with more than two traffic lanes of pavement, (b) roads having an average daily present traffic between 1,200 and 4,000 vehicles, not more than ten per cent of which is truck traffic, shall be designed with two traffic lanes,

generally paved, and (c) roads having an average daily present traffic of less than 1,200 vehicles, not more than ten per cent of which is truck traffic, shall be designed with two traffic lanes having some type of all-weather surfacing."

In considering the class to use in extending a highway system, such factors as density of population, whether the road will be used for local or long distance rapid transit, probable bus or truck routes, attraction to tourists (such as State or National parks, resorts for amusement, etc.), should be considered. Short feeder roads may carry exceptionally heavy traffic, while stretches of so-called main highways may carry a comparatively small volume of traffic. Still, speed may be more desirable on the main highway than on the short feeder road. Some Class A highways will develop into super-highways, and will then be either relocated or rebuilt and widened.

Right of Way

H. D. Palmore, *Chairman*

The majority of States have adopted certain minimum standard right-of-way widths greater than immediate needs, to provide for future widening. These vary in different states from 80 to 100 feet for main trunk highways, from 60 to 80 feet for county or secondary roads, and from 100 to 150 feet for super-highways. These appear to be adequate for any future traffic except near a very few industrial sections which have an enormous volume of traffic over short stretches.

Right-of-way is acquired in various ways, including: By county or municipality at no expense to the State; by the State by purchase, payment being based on assessed valuation; and purchase by the State by agreement or condemnation suit. Acquisition of right of way and possible resulting damage should be carefully considered so that both state and private property are protected in their rights.

The following is suggested as a means of obtaining necessary rights-of-way.

(1) That the right-of-way be acquired by the State highway departments, the county in which the rights-of-way lie to be required either to pay into the State road fund the amount of money necessary to cover the purchase price, or certain taxes now accruing to the county be diverted to the State road fund to cover right-of-way costs.

(2) That the value placed on each piece of property bear some direct relation to the assessed value.

(3) That the State Highway departments include as a bid item the removal of fences and obstructions from the limits of the right-of-way and the rebuilding of the fences from salvaged material, and the construction of a standard type of right-of-way fence where necessary. If the property owner desires a better type of fence than that constructed by the highway department, then the property owner may construct his own fence at his entire expense.

(4) That the highway department provide suitable passage onto the new road for the property owners, at least as good as that existing before the improvement, whether or not the highway is on entirely new location.

(5) That the highway department so handle the construction as to cause no damage to the property owner, and construct such retaining walls, etc., as may be necessary for protection of his property.

Visibility

Chairman*, H. R. Moffit, *Location Engineer, Pennsylvania Dept. of Highways

Thus far little or no effort has been made along lines of research to set up generally acceptable standards of safe sight distance. The author, however, described some tests made by the Pennsylvania Department of Highways to determine the distance required to bring a car to a stop when traveling at various speeds, on grades varying from level to eight per cent on a dry concrete surface.

These indicated that for a speed of sixty miles per hour on a level grade, a car equipped with four wheel brakes requires at least 216 feet to be brought to a stop. Therefore, if two drivers are approaching each other in the same traffic lane at this speed they must be able to see each other from a distance of at least 432 feet in order to bring their cars to a stop to prevent collision, assuming that neither car can turn from the lane. It is also assumed that the surface conditions of the road are good, that the braking equipment of both cars is in good condition, and that both drivers react immediately to the emergency. Since a vehicle moving at sixty miles an hour travels 88 feet per second, we must conclude that provision must be made to allow for the distance traveled at this speed during the time that the driver reacts to the emergency, and to allow for defective braking equipment and for possible unfavorable road conditions. It appears reasonable that an allowance of one second should be made for each driver. In terms of distance this amounts to 176 feet which, added to the actual minimum braking distance, gives 608 feet. It will be noted that this is a safety factor of approximately fifty per cent. Therefore, the minimum clear vision distance that should be used on all highways carrying a daily average of 1,000 cars or more should be 608 feet, or approximately 600 feet. This should be applied to both horizontal and vertical curves.

Clear sight distance is more important in a three-lane road than in a two-lane or four-lane; for the middle lane is used for passing by both lines of traffic.

The majority of vehicles now travel about 45 miles an hour, some 35 to 40, and a small number more than 45. Actual tests show that a car traveling 30 miles an hour passing one at rest will require 117 ft. to turn off the traffic lane and return to it; one traveling 60 miles passing a car going 45 miles will be off their traffic lane for a distance of 468 ft. Therefore, on a three-lane highway, and especially on vertical curves, safe sight distance should be at least 936 feet to permit passing in either direction.

Mr. Moffit therefore recommends, for a three-lane highway a minimum visibility distance of 1,000 ft.; he does not think necessary the 50% factor of safety used for a two-lane road.

The department found that horizontal curves should be so constructed that the minimum sight distance is greater than the braking distance for the maximum safe speed for the curve. It is estimated that the maximum safe speed on a 16 degree curve, super-elevated ¾ in. per foot, is 46 miles an hour; and the braking distance for that speed with four-wheel brakes is 126 ft. Therefore the minimum clear sight distance should be not less than 252 ft. Fifty per cent safety factor should be added to allow for poor brakes, unskilful drivers and other conditions, giving 378 ft.,

(*Continued on page 69*)

Save Money by Machine Surfacing Subgrades

HIGHWAY departments, their engineers and inspectors, have become very particular about the thickness of concrete laid for pavements, and rightly so—the beam strength of the pavement varies as the square of its thickness; a 5½-inch section of a pavement specified to be 6 inches thick has only 84 percent of the intended strength. There are certain disadvantages in non-uniformity of thickness even when there are no places below that specified, but excess thickness is much less objectionable and engineers usually pay most attention to deficiencies only.

To insure sufficient thickness, it is customary to impose such severe penalties for deficiency (including requiring relaying of the pavement) as to make it a decidedly losing proposition for a contractor. Most states take cores of completed contracts to determine the actual thickness, in addition to inspecting the construction very carefully, so that it is difficult for a contractor to get away with skimping the thickness.

So convinced are contractors of the determination of the highway departments to secure the specified thickness, that they are apt to get the pavement more or less thicker than specified so as to be safe. But here they lose by laying more concrete than they are paid for. A 9-6-9 pavement 18 ft. wide with 14 ft. of it 6 in. thick has an average thickness of 6.33 in., and 1,000 lineal feet contains about 352 cu. yds. of concrete. If the concrete be made ¼ inch thicker than specified, this means 14 excess cu. yds. per 1,000 ft.

In calling this matter to the attention of the Kentucky Association of Highway Contractors, "The Scraper," the weekly publication of that association, gives the results to date of core drill tests of last season's work in Kentucky as follows:

Contractor	Length Miles	*Ave. Thick	Excess Cost Due Low Sub Grade
Gorrell, Barrow & Kirkpatrick	8.497	†6.68	$3,439.44
Nelson Bros.	6.432	‡6.34	4,917.76
N. E. Stone	6.406	6.34	4,408.35
Nelson Bros.	3.015	6.15	915.35
Nelson Bros.	3.163	6.45	2,880.86
Ellis, Kelly & Co.	8.342	6.32	5,402.95
N. E. Stone	4.767	6.16	1,705.66
N. E. Stone	6.884	6.28	3,901.30
N. E. Stone	3.252	6.38	2,501.18
Foster & Creighton	15.099	6.36	11,001.74

* Computed from cores drilled from pavement.
† This pavement 9-6½-9 and 20′ wide.
‡ This pavement 9-6-9 and 20′ wide.

The excess thickness averages 0.3 inch.

The excess cost was calculated on the basis of $2.30 per bbl. for cement, six sacks (1½ bbl.) to the cubic yard, and an equal amount for aggregate and haulage. The average excess cost was figured out to be $642 a mile, or 6 cents a square yard.

This will amount to about $100 a day for a gang laying 750 feet of 20-foot pavement. If a subgrade machine were used which would bring the subgrade 0.3 inch nearer the specified thickness than was practicable without its use, then it would be economical for the contractor to use it if it cost less than $100 a day, including overhead as well as labor and fuel.

It is perhaps possible for a contractor, with expert subgrade men, to get his subgrade continuously as near the theoretical surface with hand work as he could with machine; but we doubt if many do.

Public Works and Unemployment—Financial and Other Aspects*

THE immediate responsibility for meeting the present unemployment needs by increasing public works construction is primarily a local one. While federal and state agencies should cooperate to the fullest extent in increasing needed construction work, the responsibility can be met fully and the problem solved only by employment of the comparatively flexible local agencies which exist in every community. Our form of government is based on the ability of our local peoples to govern themselves, and any workable plans for relieving the situation must proceed from that base. To rely upon the possibility of a huge governmental bond issue, or to await other federal or state aid is futile. The immediate relief so vitally needed now can be provided most quickly, most efficiently and most economically through local sources.

This means that the funds for this work to be done in the immediate future must come from local sources and cannot be procured from outside agencies. The problem of raising these funds is one that must be faced and solved by local officials if they are to do their share to meet the needs of today.

The major sources of income for public work construction are taxes, bond issues and assessments. Of these, the most important source available for early construction work is tax money. Much of this has already been (or is now being) duly authorized in the 1931 budgets, and no further action is necessary to start the work—except to make the money immediately available. For two reasons it is of the greatest importance to do this. One is the present great need for work to relieve unemployment and hasten the return of prosperity; and the second is, that if we do not spend it soon—and very soon—on *needed* improvements, it is more than likely to be spent on unneeded ones. I shall discuss this more at length a little later.

If tax money is not yet in hand, as is often the case, money can generally be borrowed from local banks at a fair rate of interest in anticipation of the receipt of taxes. Local banks have a close interest in the welfare of the community in which they do business and with rare exceptions will cooperate fully. A financial statement setting forth both income and expenditures of the city, and a clear outline of what is planned, with reasons for the expenditure, will usually be all that is necessary.

Temporary loans may sometimes be arranged between different departments of the city. For instance, the water department may at this time have funds banked that can temporarily be made available for paving work, provided adequate provisions are made for timely repayment.

To raise money by bond issue or assessments requires generally a considerable period of time—two or three months at the very least. Unless initial steps have already been taken, the result will be that work financed by these means cannot be undertaken before spring.

If each of our four or five thousand communities can begin now the work it has planned for in its 1931 budget—or a sufficient amount of it to meet the local unemployment situation—the great need will be met. It is not so much a question of increasing the volume of planned construction—though every effort should be made to carry on the maximum amount of needed work—as in getting work under way at the earliest possible moment.

The cooperation of national and state agencies in increasing construction should, and will, be given most fully, but the machinery for making this work available is not so flexible, and more time is required to get work under way. It is the duty and the privilege of each locality to carry the burden until state and federal aid roads, river and harbor improvements and public building work can be transformed from plans on paper to projects under way. Our individual communities are, and should be, the first line of defense in such emergencies.

To facilitate the work, engineers must cut red tape so that work of a basic and fundamental character can be expedited. There is a real danger that in the scramble to make work available—*any kind of work*—the real needs of the communities will be lost sight of. In too many places, the special unemployment committees have been made up of thise who feel a greater degree of responsibility for the relief of unemployment than for the needs of the community. Earnest and honest though they be, they are often not capable of outlining policies that will produce work and still serve the taxpayers of the community, giving them dollar for dollar value for their money.

What will happen too often is that work of no real value—unneeded and even useless work—will be set under way. Perhaps the reason will be that the engineer, not quite awake to the situation, is not able to pull from his desk a completed plan of some much needed work. Or such needed works may require a little more time to start, or will not employ quite so many of the unemployed, or are not susceptible to the right kind of publicity.

The result may be that many communities will find themselves in the spring with construction funds spent, in debt and having nothing tangible in the way of needed improvements. The paving scheduled for the year, the street or drainage improvements, will have to lie over because the money will have been spent on some other and perhaps less needed improvements.

The situation is the more critical, as one prominent and able city engineer has put it, because of the general feeling everywhere for the reduction in tax burden. People who are insisting that public funds be provided for taking up the slack in unemployment, regardless of the need or benefit of the work, are going to be among the most insistent also that taxes be reduced regardless of the method of reduction. If we waste our money in a riot of needless work for unemployment relief, then street paving, road work and other municipal improvements will pay through the nose during the next two or three years.

Let us cite the case of one city, with a progressive

* Paper before the American Road Builders' Association by Major W. A. Hardenbergh, associate editor of *Public Works*.

and well-planned program for drainage improvements over a period of several years, which improvements are a requisite for the growth and development of the city. The officials of this city were urged into the purchase of a large tract of unimproved land, so that the unemployed could be set to work cutting brush and clearing. In all probability that city will have no money left for drainage work this year, and likely none for next year, and needed improvements will be delayed.

Certainly there is a real need for immediate speeding up of public work construction. But let us mix brains with sentiment, and make even the relief dollar do double duty—aiding the needy and at the same time giving full value to the taxpayer. Engineers, as the leading technical officials of our cities, are charged especially with the responsibility of seeing that public funds are spent on justifiable projects, and at the earliest possible moment.

Incinerating Garbage in New Jersey Shore Resorts

There are 38 summer resort municipalities within a distance of 65 miles of ocean beach in New Jersey. Two of them are cities with permanent populations of about 15,000 each. In these municipalities ashes and rubbish were, until recently, dumped on adjacent meadows, while garbage was either dumped and partially burned or covered or was hauled to farms and fed to hogs. In hot summer weather, with the garbage of more than a half a million people so disposed of, odors, flies and rats made the dumps a nuisance, and the hog farms were no verbenas for smell. Most of the communities have adopted some remedies.

A survey made about a year ago of 51 municipalities in Monmouth County, found garbage collected and disposed of in some way in 35. In 18 it is collected by individuals under contract and fed to hogs; in 8 it is dumped and covered and in the remaining 9 incineration is employed.

Of the 51 municipalities, rubbish is collected in 33; in 22 by individuals under contract, by the municipality in 8, and in 3 by individuals without public contract.

The first of these municipalities to destroy its garbage and rubbish in an incinerator was Keansburg. This is a Morse-Boulger plant built in 1920 at a cost of $20,000 and still in operation. It contains two units, has a capacity of 20 tons in 24 hours and in summer is usually operated about 16 hours a day. During a three-day test in September, 1929, garbage and rubbish containing 47.5 per cent moisture were incinerated, with fuel in the ratio of one pound to 26 pounds of refuse. The cost of incineration was $1.31 per ton, based on cost of labor, fuel and electricity.

In 1925 Deal borough began operating a De Carie incinerator with a capacity of 15 tons in 24 hours, which cost $15,000. About three tons of garbage are produced daily and the incinerator operated twice a week. Very little fuel is used. No costs are available.

In 1927 Highlands borough put into service a Pittsburg-Des Moines Standard plant of 25 tons capacity, costing $24,900. It was operated daily for two months in midsummer at a cost for labor, fuel and electricity of 78.4 cents per ton; the low cost being partly due, it is believed, to the high proportion of dry combustible rubbish burned. Whole carcasses of horses have been destroyed in 35 minutes. In 1928

(*Continued on page 69*)

Rumson also began sending its garbage to this incinerator.

In 1928 Long Branch purchased a two-unit Pittsburg-Des Moines plant with a capacity of 100 tons in 24 hours, paying $69,620 for it. This has operated continuously since then. A careful record shows that the cost per ton was $1.35 for the first year and 94 cents the second year. More than 700 dead animals were destroyed in the incinerator during the two years and at times garbage from three neighboring boroughs.

The incineration costs at Long Branch for the year 1929, as furnished by the health officer, were as follows: Superintendent, $1,565; labor, $4,480; repairs, $318; equipment, $167; telephone, $77; water, $209; light, $13; power, $202; coal and wood, $1,801; workman insurance, $50; total, $8,882. There was burned 9,239 tons of garbage and 251 tons of rubbish.

Rumson borough installed in 1929 a 20-ton Pittsburg-Des Moines Standard plant at a cost of $48,000, the level land necessitating a long concrete ramp, which increased the cost. Wood is used for fuel. The cost for labor, fuel, water and electricity was estimated at $3.07 a ton.

Asbury Park completed in 1930 a 180-ton Pittsburg-Des Moines plant, Red Bank a 50-ton incinerator, and Spring Lake a Morse-Boulger. In addition to these municipalities which own incinerators, Fair Haven, Little Silver and Sea Bright disposed of their garbage in the incinerators of neighboring municipalities.

Abstracts of Papers at the A. R. B. A. Convention

(Continued from page 63)

or say 400 ft. For curves exceeding 8 degrees, extra width must be added to the pavement.

Adequate clear vision distance should be given more careful consideration in constructing vertical than horizontal curves; for the former can not generally be changed later without interrupting highway service, while obstacles to sight on a horizontal curve can generally be removed later.

At least 600 ft. clear vision should be provided on highways carrying 1,000 or more vehicles a day where the alignment is winding and curves close together, even if the profile is uniform, to permit rapid vehicles to pass slow ones without danger; also at each curve that terminates a long straight stretch, which invites speed.

At road intersections not controlled by police or traffic lights, good visibility must be provided—equal to that required on tangents. Where the paved surface is 20 ft. wide, an additional lane should be provided on each side (40 ft. additional in all) for a distance of 150 to 200 ft. back from each intersection where there is much cross traffic.

Visibility at railroad grade crossings is important. (See the abstract "Grade Crossing Elimination..")

Where visibility can not be obtained without great expense, ample and unmistakable warning signs should be used. On both horizontal and vertical curves, traffic lines should be painted on the surface.

Advertising signs, trees and undergrowth that interfere with visibility at curves and intersections should be removed and prevented.

To summarize, we recommend that:

1. For all classes of highways of two or four lanes carrying 1,000 vehicles or more a day, a minimum sight distance of 600 feet should be provided.

2. For a three-lane highway, 1,000 feet clear vision distance is recommended.

3. For two-lane highways carrying from 500 to 1,000 vehicles daily, where sharper curves are necessary because of the problems of financing, a minimum clear vision distance of 400 feet is recommended—500 feet, if possible within the limits of economy.

4. For two-lane highways carrying less than 500 cars daily, 300 feet is recommended. This is based on providing for a speed of thirty miles an hour on an eight per cent grade with a fifty per cent allowance as a safety factor.

Allowable Grades for Highways

Chairman*, C. H. PURCELL, *State Highway Engineer, California

This report is such a complete and concise summing up of the various factors entering into the establishment of highway grades, that we expect to publish it in full, probably in the next issue.

Mr. Purcell holds that "the allowable in grades is not limited by amount of power but by the economic use of available power and in the safety with which it can be applied efficiency. . . . To more or less extent, as local conditions present them, the principal features desirable on proper grade design are economy in construction costs, safety and visibility, economy in car operation, and satisfactory drainage."

Training Operators for Filtration Plants in Small Towns

(Continued from page 57)

ferences on water purification and this idea for training seems to be more favored.

The Conference School

The conference school method is gaining some favor and should prove very helpful in those states which might be classed in the second of the three groups referred to previously. For the more highly trained men, the subjects of the conference are of most interest; while for the untrained men, the school is of most importance. In any method of training, the time factor must be taken into consideration, as well as the capacity of those attending for retaining the subject material covered. Again, a distinction must be made between the technical and non-technical men, because the technical man, trained to study and observation, can retain more material and store it away for future reference than can the untrained men. He can also retain his interest in this work for a longer period of time, particularly in listening to lectures and papers. Lectures and papers, with possibly some laboratory work during the day, should provide sufficient work without asking attendance during the evening for the purpose of further work.

Subject matter should be selected with consideration of the type of men attending. A mixed group makes for more difficult selection, and more so in this type of training because it is assumed that probably fifty per cent of those attending are trained men, while many are not operators. It is hardly possible to limit the attendance to those actually in charge of operation, but invitations to attend are usually sent to include any of the city officials who care to come. Under the above conditions, the subject material must

be selected with a view of interesting all at the conference school. Individual laboratory work would be somewhat difficult, if at all practicable. Demonstrations of laboratory technique could be made, but this is open to objection unless the student can make the actual tests himself and observe the technique and results.

The conference school requires the cooperation of another agency, preferably the state university, in order that laboratories and lecture rooms be made available. The university is or should be willing to lend its help in a project of this character, because it can strictly be classed as a part of the extension work which is carried out by the majority of the state universities. Another very important feature in this arrangement is the help given by members of the faculty of the university, particularly on certain subjects with which they are more familiar, and—a most important point to be considered—their knowledge of the proper methods of lecturing and presenting the material in the best manner, especially to untrained men.

The Short School

The strictly short school idea has much to be said in its favor. It should be understood that this method is particularly suitable for the untrained men. Cooperation with the state university is essential, for the reasons stated under the school conference. A suitable lecture hall and laboratory of sufficient size to accomodate the class should be available. If there is a college of sanitary engineering, probably better facilities can be found than in a strictly chemical laboratory. It will generally be found necessary to limit the attendance to the number which can be handled with ease and to the best advantage. Interest should be instilled in the city officials or owners of private water companies sufficient to make them realize the importance of training for their operators and to take advantage of the opportunity offered for them to receive it.

A five-day school is a good length of time, and those attending should realize that it is a school organized for their benefit and what they get out of it depends entirely upon them. Promptness in attendance is absolutely necessary, and it is also well to impress them with the fact that the school is not a convention, therefore entertainment has not been provided. All of the above can be told without arousing a dislike for the school, and in fact can be made to liven their interest. The city or water company should defray the expenses incurred by the operator attending, because finally it is to be advantageous to them in bringing about improvement not only in the effectiveness but also in the economy of operation.

The course is usually divided into lecture and laboratory periods, one given during the morning and one during the afternoon. Selection of the material to be covered requires very careful thought. Due regard should be given to the fact that most of the men, while they have had some experience in operation, lack a knowledge of the fundamentals. Working on the above plan, lectures covering the various integral parts of purification plants, given in a practical manner, with illustrations if possible, have been found very satisfactory. The faculty to give these lectures must be carefully selected, in order that the students will get the most out of the talks and retain their interest in them. The students should be given a syllabus of each lecture and the lecture should follow the syllabus closely in order that they can use it to advantage at some later time.

Preceding laboratory exercises, a lecture covering the work to be given, along with a demonstration of each exercise, should prove very helpful. In this regard it must be remembered that the majority of the students have no fundamental knowledge of chemistry, and the lectures must be arranged and given in such a manner that the students can comprehend them. The application of results to plant operation can be stressed.

Each student should be given the opportunity of doing every laboratory exercise himself. After seeing the tests actually made, doing them himself will serve to impress the technique on him. Division into small groups, each under the supervision of a member of the faculty, gives a chance for more individual instruction.

The first school can cover the generally accepted tests necessary for the proper operation of a plant, which may be termed the minimum recommended tests. They include turbidity, color, alkalinity, pH, hardness and free carbon dioxide for the physical and chemical determinations; and the bacteriological work covers the total count on agar 37 degrees 24 hours, and the presumptive tests for B. coli. Continuing the school in succeeding years, more advanced subjects are taken up which affect operation; and in the laboratory, chemical and bacteriological work can be supplemented by demonstrations and exercises in the hydraulic and electrical laboratories. Microscopy of water can be given, it is believed, and in many instances be of immense help to the operator.

In the foregoing the writer has only attempted to draw attention to the various methods used in training operators, with specific thought given to the non-technical operators. Technically trained men can and should maintain their interest in operation, while this interest has to be stimulated in the case of the non-technical men and of the city officials. It is safe to say that any non-technical man can so increase his knowledge of water purification processes as to obtain a better idea of his work and operate his plant more economically. As his interest increases, he puts himself in a better position to solve the problems which are always present.

Essential Facts About Brick Pavements

(*Continued from page 31*)

It is true that some brick pavements laid thirty years or more ago do not meet this standard of smoothness. But at that time pavements were constructed for traffic low in both volume and units loads, but construction methods have been developed to meet present-day traffic. The change from cement grout to asphalt as a filler material, providing relief from stresses set up by changes in temperature, has been one of the major reasons for the continued smoothness of brick after initial construction. Reduction in the depth of the sand cushion from most anything to one inch or less has assisted in maintaining the original contour by preventing shifting and consequent increase of impact stresses; while closer analysis of raw materials and more rigid tests after manufacture have assured the production of bricks of uniform hardness, preventing uneven wear. These, with other attendant phases of modern construction, assure not only the long life of brick pavements but that this long life will be attended by the smoothness demanded by modern traffic.

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

News From the Engineering Field

National Paving Brick Manufacturers Association

The association will hold its twenty-fifth annual meeting—a silver anniversary—at the William Penn Hotel, Pittsburgh, Pa., on February 5th and 6th.

On Thursday morning "Modern Practices in Brick Paving" will be the topic, when Lyons Mussina will discuss "City Streets"; Richard M. Rumsey, "County Highways"; and Sam F. Pace, "From the Contractor's Viewpoint." Also Roy W. Crum will talk on "Highway Research."

In the afternoon "Brick Fillers and Bedding Courses" will be the subject of a paper by Prof. J. S. Crandell and discussion by P. J. Freeman, Luke Savage and Prevost Hubbard. "A Brick Pavement with Metal Base" will be described by Truman L. Flatt and a representative of the Nat'l Ass'n. of Flat Rolled Steel M'f'rs.

The day will conclude with the annual banquet.

Friday morning "Pavement Foundations" will be the subject of a paper by A. T. Goldbeck and discussion by J. S. Burch, Jr. "Brick for Street Railway Paving" is the title of a paper by A. Taurman, to be discussed by R. H. Simpson.

In the afternoon the topic will be "Brick Boulevard Construction," and the Ohio River Boulevard will be described by E. L. Schmidt; Camp Bowie Boulevard by T. A. Van Amburgh; and Brecksville Road by Fred. R. Williams; followed by discussions by E. C. Blosser and George Hockensmith.

The session will end with a talk on "The Clay Products Institute of America" by Prof. T. R. Lawson.

Association of Highway Officials of North Atlantic States

The seventh annual convention of this association is to be held at the Hotel Ambassador, Atlantic City, N. J., on Feb. 18, 19 and 20. Details can be obtained from the secretary, A. Lee Grover, Trenton, N. J.

Engineers Club of Philadelphia

A meeting to discuss Concrete in Building Construction will be held on February 17th in the auditorium of the Engineers Club of Philadelphia. At a session in the afternoon from 2:30 to 5:30 the following papers will be read: *Concrete Masonry Back-Up*, by W. E. Rosengarten, engineer, Lower Merion Township, Pa., and Horace T. Campion, consulting engineer, Philadelphia.

Influence of Concrete on Architectural Style, by F. S. Onderdonk, Prof. Architectural History, University of Michigan, and W. E. Hart, Portland Cement Association, Chicago, Illinois.

Decorative Concrete, by John J. Early, Sculptor and Architect, Washington, D. C., and Walter H. Thomas, director of architecture, City of Philadelphia.

Inspection & Testing of Concrete Structures and Materials, by Miles N. Clair, Thompson & Lichtner Co., Inc., Statler Bldg., Boston, and Meyer Hirschthall, concrete engineer, D. L. & W. R. R.

There will be a dinner from 6 to 7:30, after which the following papers will be read:

Lightweight Aggregate—F. E. Richart, Research Associate Prof., Theoretical & Applied Mechanics, University of Illinois. A. W. Munsell, Engineer of Masonry Inspection, Port of New York Authority.

Developments in Design—a. Tall Buildings: Frank Randall, Consulting Engineer, Chicago, Illinois. A. R. Lord, Consulting Engineer, Chicago, Illinois. b. Rigid Frames: A. G. Hayden, Design Engineer, Westchester Co., Parkway Comm., New York. George E. Beggs, Prof. of Civil Engineering, Princeton University. c. Floor Finishes: John G. Ahlers, Secretary, Barney-Ahlers Construction Corp., New York. Charles Schwertner, Sauter and Schwertner, General Contractors, Phila.

The committee in charge of the meeting comprises: F. O. Dufour, chairman, W. H. Gravell, John F. Harbeson, W. E. McComas, P. M. Taylor, T. P. Watson, and Chas. E. Billin, secretary.

New Jersey Sewage Works Association

The sixteenth annual meeting of this association will be held at the Hotel Hildebrecht, Trenton, N. J., on Friday and Saturday, March 20th and 21st. Floyd A. Hoffman of Morristown is president and John R. Downes of Bound Brook is secretary.

J. Walter Ackerman, formerly City Manager of Watertown, N. Y., and more lately connected with the Community Water Service Company, is now City Manager of Fall River, Mass.

Horace Wesley Clark, inventor and manufacturer of meter boxes and other water works supplies, died on January 19, aged 59, after several months of ill health. He was born, lived and died at Mattoon, Ill. His father bought the local waterworks and made him superintendent and later he assumed ownership and all management. He patented his meter box in 1902, formed the H. W. Clark Co. to manufacture them. He made some fifty inventions pertaining to water works equipment. He was one of the founders of the Illinois Water Works Association and member of the American Water Works Association, New England Water Works Association and Southwest Water Works Association.

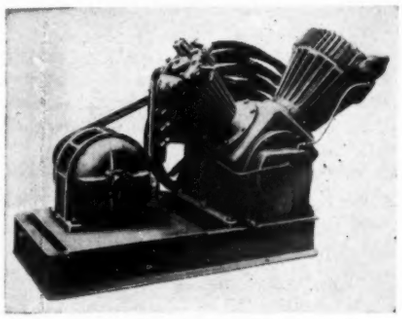
FOR COMPLETE REPORT OF A R B A CONVENTION SEE PAGE 34

Equipment for Construction Economy

New I-R Compressor for Outdoor Service

A new 2-stage, air-cooled, electric-motor-driven air compressor that can be used in outdoor or exposed locations throughout the year without danger of freezing is a recent addition to the Ingersoll-Rand line. The outfit is made in two styles; a direct-connected unit for installations that are fairly permanent, and a V-belt-driven unit for contractors and others who desire a semi-portable machine.

This compressor, Type "TLC," is particularly applicable to structural steel work and general contracting service, since it requires no water connections. The compressor and its driving motor are mounted on a single subbase, making a compact, self-contained unit that may readily be moved. A lifting bale can be attached to facilitate moving from floor to floor, or for handling on and off a truck. The "TLC" has a piston displacement of 155 cu. ft. per minute and is designed for 100 pounds discharge pressure.



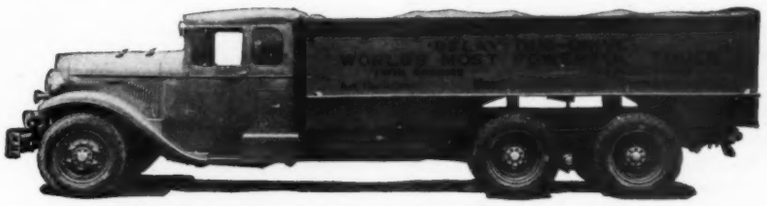
New Ingersoll-Rand Compressor

A New Speeder 3/8-Yard Shovel

Speeder Machinery Corporation of Cedar Rapids, Iowa, announces a new full revolving 3/8-yard machine. The company states that this machine incorporates all of the features of their 1/2-yard shovel, and in addition, other features necessary to high speed traveling and operating conditions.

With a 14-foot boom and 10-foot dipper sticks as standard equipment, this unit employs a 41-hp., 4-cylinder motor. The shovel boom may be removed and either a 22-foot, 24-foot, or 26-foot boom for crane or dragline operation may be attached. A pull shovel or a skimmer scoop may also be used. Other specifications of this new unit follows: Electric lights and starter as standard equipment; optional two or four speed transmission; fully enclosed cab; Speeder patented cable crowd; five complete swing revolutions per minute; travel, 3 m.p.h.; 14" tread shoe; very short tail swing; overall width, 7 feet; weight, 10 tons; all gears enclosed and running in grease.

New Speeder full revolving shovel



Relay Motors Corporation employs multi-motor principle

New Marion Mules

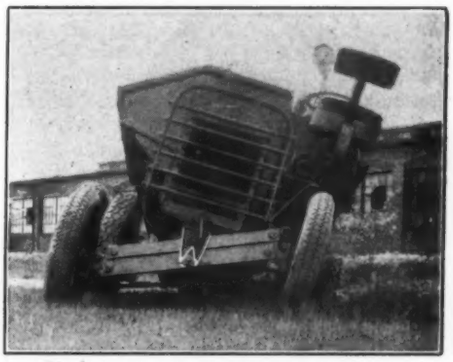
The Marion Steel Body Company, Marion, Ohio, manufacturers of Marion dump body equipment have recently acquired control of The R. J. W. Mfg. Company of Bucyrus, Ohio, manufacturers of steel mules. The acquired company has been reorganized under the name of Marion Mules, Inc., and announces a new and improved product to be known as the Marion Mule.

The power unit is a McCormick-Deering Model 10-20 Industrial Tractor unit. Transmission has four speeds forward, one reverse. The body is 4 cu. yd. capacity and may be increased to 5 cu. yds. with sideboards. It is gravity operated and when in lowered position easily bull-dozes the load.

With crawler tracks the Marion Mule has a speed of six miles per hour; steel wheels at nine miles per hour; and pneumatic tires at twelve miles per hour.

A 275-hp. Twin Engine Motor Truck

A new type of truck introduces the multi-motor principle for the first time as a means of developing power, hauling capacity, and speed hitherto considered impossible. The new truck, just announced by the Relay Motors Corporation of Lima, Ohio, is a dual-engine, six-wheel, heavy duty model. So powerful is the new model that double loads in excavation or building construction jobs, a capacity of four to six yards of wet mixed concrete, or 5,000 to 10,000 bricks or tile, in a single load are possible.



The oscillating front axle has many advantages

The new truck is equipped with two straight eight cylinder truck type engines with a combined power of 275 brake horse power at 2,800 R.P.M. Each engine delivers power to separate Relay rear axle. Having two separate rear driving axles overcomes many of the difficulties encountered in the operation of other six-wheel trucks.

The engines may be used in combination, or one at a time. Each engine has its own transmission. An air mechanism shifts the twin transmissions

Recent Developments in Apparatus

in perfectly synchronized time. One level will shift both gears when both engines are in use. Two simple movements from the driver's seat connect or disconnect either engine.

Safety and quick stopping facilities have been provided by heavy duty air brakes, with cast brake drums and moulded brake blocks on all six wheels, and air connections for trailers. Twin emergency brakes offer an added margin of safety in stopping.

Improved riding qualities, saving on tires, and better distribution of the load are possible in the new model because of the Relay axle. This Relay principle which suspends the load like a pendulum, allowing it to swing back and forth, greatly reduces horizontal impacts on all the rear wheels. It is an important factor in protecting the roads over which the truck travels.

The Toledo Aggregate Auto Gage

An aggregate auto gage has recently been announced by Toledo Precision Devices, Inc., a subsidiary of the Toledo Scale Company, Toledo, Ohio, manufacturers of Retail and Industrial Scales.

Once having determined the moisture content of the regular run of each aggregate, this device will automatically and correctly weigh out the specified amounts of the various aggregates, compensating for the surface moisture in each. Cement and water can then be added by weight in right proportion, if desired.

This gage will determine the specific gravity of concrete aggregates and the percent of moisture; compensate for surface moisture; show exact weight of dry aggregates; indicate the weight of regular run aggregates; show actual weight of surface moisture; make sieve analysis; show moisture within the aggregates themselves, and do regular weighing.

Pease New Inexpensive Sheet Dryer

The new Pease "Junior" Sheet Dryer, manufactured by The C. F. Pease Company, 813 North Franklin Street, Chicago, Ill., is an inexpensive dryer for moderate size blue-prints, negatives, blue-line and brown-line prints up to 24 inches wide. Also, when a chromium plated cylinder is used, it is particularly adapted for drying photo prints.

An Insulated Cab for Motor Trucks

The Metropolitan Body Co., Bridgeport, Conn., has brought out a new type of insulated motor truck cab.

The insulated one-piece steel roof eliminates drum and rattle from within the cab and affords protection from heat or cold. Adjustable seat and lazyback insure an instantly comfortable position for all drivers—big or little. The cushions are of the Metro soft spring air type. Clear vision one-piece windshield and two-piece rear window afford maximum vision, front and rear, together with ample ventilation.

The entire cab has insulated air pockets between the outer and inner walls. The new Metro three point mounting utilizes a ball bearing and compensating springs. This adds to comfort and to life of cab and chassis.

Left: The Toledo Aggregate Gage

Right: The Insulated Motor Truck Cab made by Metropolitan

The Pease Print Dryer

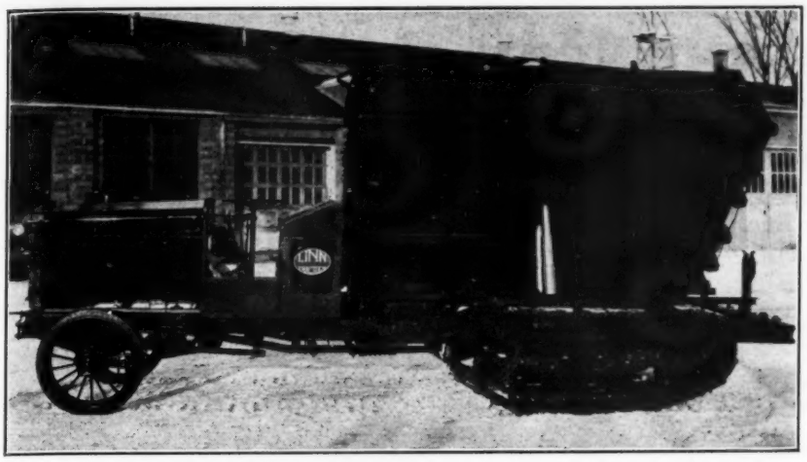
Construction Equipment Data

Wheeled Scoops.—W. A. Riddell Co., Bucyrus, O., has issued a folder describing this economical method of moving dirt.

Wiley Whirley Cranes.—A new edition of the Wiley Whirley Catalog, differing materially from the old one, has been issued. It describes this traveling, revolving, long reach, heavy duty steel derrick for clamshell, dragline and hoisting work.

Construction Grader.—The Caterpillar Super Reliance grader is a heavy duty construction grader for use with the "60" tractor. Described in a beautifully illustrated folder issued by the Caterpillar Tractor Co., Peoria, Ill.

Trailer Patrol Maintainer.—Caterpillar Tractor Co., Peoria, Illinois, has issued an illustrated folder describing the Detachable Trailer Patrol Maintainer.



Linn Tractor equipped with side-tipping elevating grader body. Note absence of complicated mechanism on understructure

Price Reduction for New Linn Tractor

A substantial reduction in price for the new Linn tractor (model 6-28-F) marks the Linn Manufacturing Corporation's first move of 1931. G. R. Hanks, president of the corporation, comments as follows on the reduction:

"Due to the decreased cost of production, we find that we can reduce the price of the new Linn without lessening the standard of workmanship and quality that we have set and maintained for ourselves. With the millions of dollars appropriated by national, state and local governments for the building of roads and for public construction in 1931, we look for a good tractor year, and we are ready to meet it with the new, improved Linn."

Many important improvements of construction are featured in this new model. To give greater traction, each string of lags contains 29 units instead of 26, giving 1,400 square inches of track surface in contact with the ground instead of the former 1,100.

Three track springs in clover leaf formation with a stop pin in the track-adjusting bar relieve the constant tension of the track on the rear driving sprocket when driving ahead. When operated in reverse at high speed, the track springs come into play, keeping the track tight so that the lags do not buckle or catch in the rear frame.

The new model also has a fuel pump in place of a vacuum tank; a new and improved type of high-speed reversing transmission which connects directly with the clutch; continuous side-frame channel and the new improved steering wheel worm gears.

The new side-tipping elevating grader body doubles the dumping utility and combines ease of operation with simplicity and ruggedness of construction. It is equipped with an especially designed commercial shearing and stamping three-sleeve hoist, which dumps to either the right or left, but not to the rear, and provides a tipping angle optional with one's need. Sturdily built automatic down-folding gates on each side raise, lower and lock into position automatically. When flush with the body, they permit an early release of the pay load and a clear passage for boulders and large chunks of dirt. The loading capacity is 8 cubic yards. A rim board, which may be used on right or left side of the body, depending on the position of the grader, gives additional loading capacity.

The loading height of the new body is only 5′ 7″; there is no projection on the rear of the body to bump the grader when the tractor is fully loaded and is driven out from under the grader.

Another body is equipped with an automatic down-folding tail gate, sturdily built and well able to withstand heavy weights and pressurers, which has several distinct advantages over the ordinary board. It is a time saver; controlled from the driver's seat by a lever, it saves a man the trouble of getting out to raise or lower it. Immediately as the body lifts, the gate begins to open and the pay load begins to spill out, relieving the hoists of stress and strain. In dumping, when fully open, it provides an absolutely free passage for the discharge of boulders, large chunks of dirt and similar materials. And in hauling operations, it can be locked flush with the sides of the body for the carrying of dirt, snow and bulky loads, or locked fully open for the transportation of girders and logs.

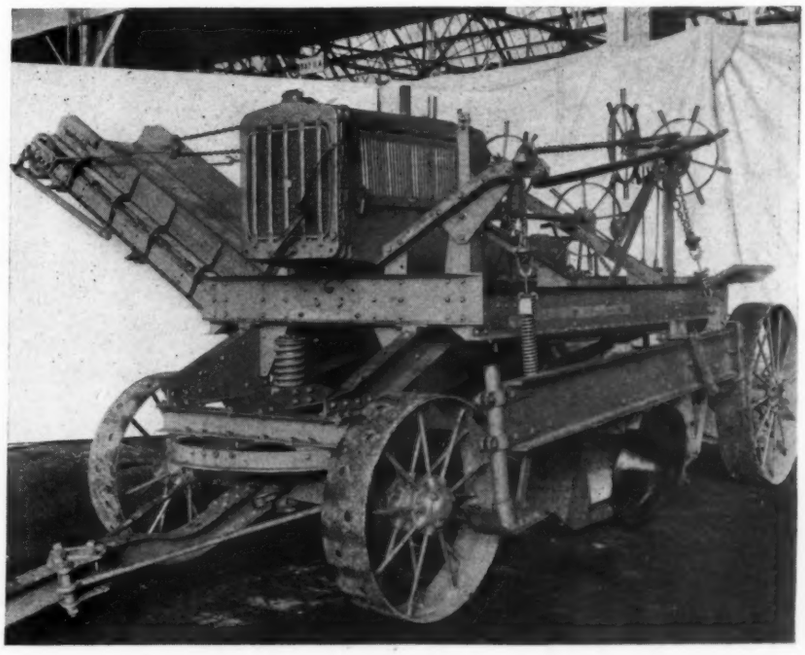
Caterpillar Sixty Elevating Grader

The latest elevating grader of the Caterpillar Tractor Co., "unveiled" at the Dealers' Convention January 8th, is shown herewith. Attention is called to the operating power—a 4-cylinder, which develops 25 horsepower at the carrier belt, through reducing gears aided by anti-friction bearings. The carrier is 16 to 19 feet long.

1931 Keystone One-yard Shovel

The new 1931, Model 17, one-yard whirler, a convertible power shovel manufactured by the Keystone Driller Co., is described as a completely flexible machine, full revolving and full crawler mounted, equipped with skimmer, pullscoop, dipper or bank shovel, crane, clamshell, dragline bucket, magnet and pile driver. It weighs 28 tons complete with each equipment, except the standard bank shovel, which increases the weight by two tons. It has been designed to give exceptional efficiency with the skimmer bucket for street and highway excavation, and with the pullscoop or back-hoe bucket in ditching.

To secure exceptional stability and permit accurate finishing of the grade with a skimmer bucket, the machine is mounted on a roller path 71 inches in diameter, with hold-down shoes which tie the upper structure to the crawlers. The 21 ft. boom provides horizontal



Caterpillar "60" elevating grader with engine belt drive

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

crowding movement of 14 ft. 9 in., so that the bucket can readily be filled in a 4 or 6-inch cut at one shot—especially useful for grading streets and for shallow excavation. Since the machine will excavate over a radius of 28 ft. 6 in., it is possible to cut and finish grade from curb to curb of a street 50 ft. wide, at one set-up. The one-yard bucket gives the machine a capacity of over 800 cubic yards per ten-hour day in ordinary excavation, and the full revolving features makes it possible to handle deep cuts to good advantage, loading the bucket in front of the machine and dumping it at the rear.

Pullscoop buckets in sizes from 24 to 48 inches are standard and have capacities of from ½ yard to one yard over the range of sizes mentioned. Buckets of 54 inch, 60 inch and 72 inch are available for use where work is required to those widths. The shovel has a digging depth capacity of 20 ft. and an extreme depth reach of 24 ft., and an extreme reach at the ground level of 25 ft. 6 in. from the center pin. Dumping height with the ditcher bucket is 11 feet. Dumping clearance with the skimmer bucket is 15 feet.

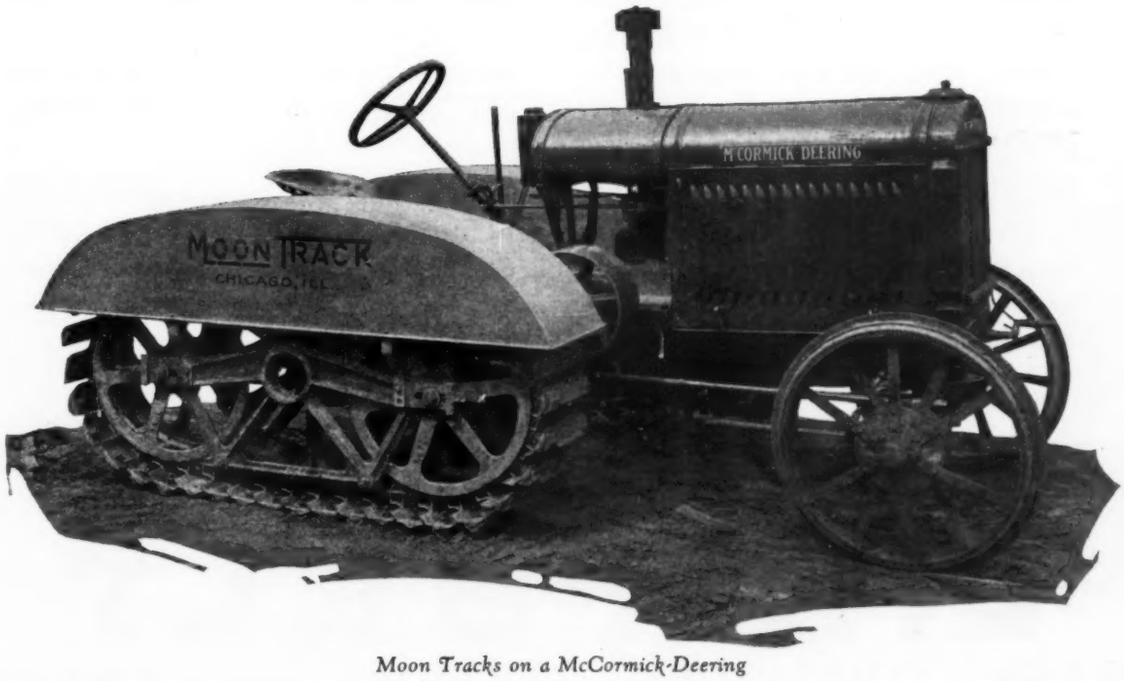
The boom and digging buckets for skimmer-pullscoop operation have been made exceptionally light, the boom weighing about 2,500 lbs. and the one-yard skimmer or 48-inch ditcher with attachments about the same. Thus the dead load on the front of the machine is only about 5,000 lbs, making it possible with a moderate amount of counterweight to keep the rear end clearance or tail swing of the machine within the limit of 8 ft. 6 in. from the center pin. It also greatly increases the possible pay load and produces a one-yard shovel weighing only 28 tons.

Keystone Model 17 one-yard whirler

Moon Track Construction

Moon Tracks are semi-crawler tracks for McCormick-Deering tractors (also available for J. I. Case Model C and Allis-Chalmers Model D industrial tractors). They can be attached to a tractor in a little over an hour, being attached direct to the rear tractor axles in place of the drive wheels. The steering mechanism, including the front wheels, remain intact. The tracks can be equipped with either a round tread shoe for finished roads, or a grip or sharp tread shoe for soft ground. The construction of the tread automatically cleans the tracks, whether the soil be thick and heavy or loose and sandy. They are made by the Moon Track Co., Chicago, Ill.

A well-filled bucket



Moon Tracks on a McCormick-Deering

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

Construction Materials and Equipment

Air Compressors

What Portables Do.—Ingersoll-Rand Co., 11 Broadway, N. Y., has published an interesting booklet "What Portables Do." This shows portable air compressors at work on a variety of everyday jobs, and shows the important part they play in reducing costs and speeding up maintenance work. 32 pages, illustrated.

Rotator Hammer Drills.—Bulletin 87-C—8½ x 11, 12 pages. Describes the new Sullivan "L-8," 39-lb. Rotator Hammer Drill for general rock excavation purposes in mines, quarries, and on construction work. Complete with table of equipment, etc.

"S-2" Heavy Duty Stoper.—Bulletin 87-E.—This bulletin describes the new Sullivan water stoper for mine service. Four pages, 8½ x 11.

Rock Drills and Portable Hoists.—The Sullivan Machinery Co., Chicago, Ill., has issued three new bulletins: 87-D describes the I-6 Rotator rock drill; 76-M describes Sullivan Turbinair portable hoists, which are built in a number of sizes, and 76-L, which covers the Sullivan Cathead, which may be operated by compressed air or steam. This is a handy and economical winch.

Locomotives

Brookville Locomotives.—Brookville Locomotive Co., Brookville, Pa., has issued Bulletin B-27, which gives a great deal of information and tabular data helpful in selecting the particular weight and type of locomotive, as determined by: Load, grade, track, curves and car friction.

Power Shovels

Large Power Shovels.—The rugged construction and rock digging ability of the Bucyrus-Erie 4-yard, 120-B shovel is emphasized by illustration and text of the new Bulletin D-1203 recently issued by this manufacturer. Interested readers may obtain copies by writing Bucyrus-Erie Company at South Milwaukee, Wisconsin. We hope, of course, you'll remember to mention PUBLIC WORKS.

3-Yard Shovles.—One of the recent bulletins of Bucyrus-Erie Company, South Milwaukee, Wisconsin, describes that company's 100-B, 3-yard electric or steam revolving shovel. The 24-page booklet is excellently illustrated, contains a full mechanical description and complete specifications of this powerful machine for heavy digging. Copies may be obtained on request to Bucyrus-Erie by mentioning this publication.

Bucyrus Diesel.—The Bucyrus-Erie Co., South Milwaukee, Wis., have issued a new illustrated bulletin describing the new 2¼-yard, 52-B diesel shovel-dragline-crane-clamshell. It is powered with a 6-cylinder, slow speed, Atlas-Imperial full diesel engine.

Road Building

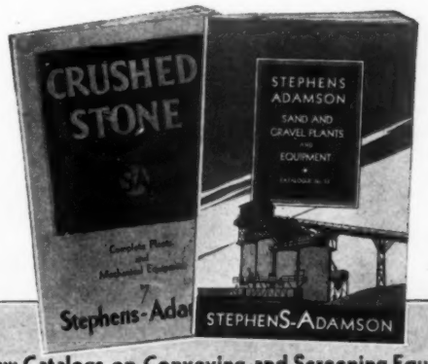
Building Roads.—An excellent and valuable booklet issued by Caterpillar Tractor Co., which explains how roads can be built better and cheaper with machines than with man-power. Its 68 pages are right to the point, and are well illustrated with construction pictures showing just how the work is done. Anyone can get a copy of this valuable text by writing the Caterpillar Tractor Co., Peoria, Ill., or by asking PUBLIC WORKS.

Construction Materials

Curing Concrete. — This 12-page booklet gives full data on curing concrete by the Hunt Process. The process is described, curves showing results of curing by this and other processes as shown by core tests are presented, and specifications are given. McEverlast, Inc., 111 West Seventh St., Los Angeles, Calif.

Stone, Sand and Gravel Plants.—Stephens-Adamson Mfg. Co. of Aurora, Illinois, has just printed two 72-page catalogs describing conveying, screening and washing equipment. One catalog is devoted exclusively to the crushed stone industry while the second features equipment for sand and gravel plants. Both books are alike in that they specialize in recent developments in plant arrangement and new units for producing and handling high grade specification material. The opening section of each book has some very good suggestions for the survey that should always be made not only in designing new plants, but in keeping present plants up to date. The material includes a consideration of the deposit, market requirements, future developments and the best methods for producing the required products. A number of pages are given over to successful arrangements that have been used recently in plants ranging in size up to those capable of producing, storing and shipping hundreds of thousands of tons.

Either or both of the two catalogs will be sent to those making their requests to the Stephens-Adamson Mfg. Co. Catalog Department at Aurora, Illinois, or use the form on page 133 of this issue.



Two New Catalogs on Conveying and Screening Equipment for Sand and Gravel and Crushed Stone Plants.

Construction Equipment

Traction for Action.—The Caterpillar Tractor Co., Peoria, Ill., has issued an interesting booklet telling the "why" of track-type tractors.

Moving Dirt.—The Austin-Western Road Machinery Co., 400 No. Michigan Ave., Chicago, Ill., has issued an illustrated folder describing crawler wagons and elevating graders.

Pipe Line Power.—A new circular which describes the economy and efficiency of Trackson Crawler pipe handling units for lining-up, tying-in, lowering-in, backfilling, cold-bending, and other pipe line work. It is illustrated with photographs of Tracksons in operation on actual jobs and gives complete specifications of the new Model GH Trackson Crawler, which is especially suited to the pipe line field. Write the Trackson Company, 1320 So. First St., Milwaukee, Wis.

Motor Graders. — A new motor grader catalog has just been issued by The Austin-Western Road Machinery Co., Chicago, covering in detail all the latest developments of the Austin four-wheel drive machine known as the Dual Drive, including single drive units. The book will be of special interest to those who are particularly concerned with fine grading and leveling, coupled with speed at low costs. Austin Dual Drive Motor Graders are furnished in three sizes: Models 20, 12½-25, and 30; the single drives are furnished in two sizes: Models 20 and 30. The machines may be variously equipped with pneumatic tires, crawler treads, power drag attachment, scarifier, snow plow and snow blade, providing units that can be worked at top notch efficiency the year around. Copies will be mailed upon request, without any obligation whatsoever. Ask for Catalog No. 9.

NEWS FROM THE DISTRIBUTING FIELD

The appointment of F. J. Selinger, Jr., as Sales Manager has been announced by the Pennsylvania-Dixie Cement Corporation. His headquarters will be at 521 Fifth Avenue, New York City. B. W. Druckenmiller is Assistant General Sales Manager.

The Northern Road Equipment Co., 82 St. John St., Portland, Maine, has been appointed distributor for Trackson tractor equipment, and will carry stocks, and repair and replacement parts.

N. G. Livingston has been appointed Eastern Sales Manager of the American Tractor Equipment Co., Oakland, Calif., makers of dirtmovers, bulldozers, tampers and scarifiers. Mr. Livingston will operate from the Peoria, Ill., plant of the company.

The Equipment Corporation of Arizona at Phoenix, F. C. Crane Company of Dallas, Texas, Joe C. Tucker of Morganfield, Ky., Track-Type Tractor and Equipment Company of Amarillo, Texas, and Concrete Products Company of Oakland, California, will handle the complete line of Rex Construction Equipment. This line includes Rex Mixers in ½ to 12 bag sizes, Rex Pavers and Road Pumps, Rex Saw Rigs, Rex Contractors' Elevators, Rex Moto-Mixers, Rex pumps, Centrifugal, Diaphragm, Plunger and Self-Priming Centrifugals. Also Plaster and Mortar Mixers. In addition to these new construction equipment distributors, the Chain Belt Company has appointed the E. C. Atkins and Company, Inc., of Memphis, Tennessee, as chain and power transmission representatives. The Atlanta office of the company has recently been moved to 407 and 408 Bona Allen Building, Atlanta, Ga.

Lecourtenay Company, Newark, N. J., manufacturers of centrifugal pumps, announce the appointment of F. J. Moran as Philadelphia district manager, with offices in the Witherspoon Building.

J. B. Downey, 2944 North Second St., Phoenix, Ariz., has been appointed representative for that state for the Dayton-Dowd Co., Quincy, Ill., manufacturers of centrifugal pumps.

The Paradon Manufacturing Company, Arlington, N. J., announces the appointment of Percy L. Luck, 1811 Masonic Temple Building, New Orleans, La., as their representative in New Orleans.

The Owen Bucket Co., Cleveland, Ohio, has opened a new branch office and warehouse for New York at 36-25 Twenty-Second St., Long Island City. Frank W. S. Elmes is in charge.

H. S. Greene, formerly general sales manager of the Barber-Greene Company, Aurora, Illinois, has been elected to a similar position with the Chain Belt Company of Milwaukee, Wisconsin, manufacturers of chain, conveying and construction equipment.

H. B. Owens, for 15 years in the producing end of the oil fields and natural gas business, has joined the Caterpillar Tractor Co. to develop this field for Caterpillar tractors. Mr. Owens' new title is supervisor of industrial sales.

Among the new distributors who have been appointed recently by the Trackson Co., Milwaukee, Wis., to handle Trackson tractor equipment for the McCormick-Deering tractors is the Gierke-Robinson Co., 4th and Repley Sts., Davenport, Iowa, who will cover the Davenport, Des Moines, Cedar Falls, Fort Dodge, Mason City and Dubuque territory.

The Genfire Steel Company has been incorporated with the Truscon Steel Company, and will function as its dealer and commodity division under the direction of W. B. Turner, formerly manager of the Genfire Steel Company. The sales organization of the Genfire Steel Company is being kept intact and merged with the Truscon sales organization to function in this specialized capacity.

Formerly manager of engineering and sales Fort Pitt Steel Castings Company, McKeesport, Pa., Charles A. Lynch recently was appointed vice-president and general manager of the Foote Company, Inc., Nunda, N. Y. He has been identified with the steel castings industry for 23 years and for the past five has been engaged in an intensive study of machinery and equipment materials.

Concurrent with the filing of a deed covering 418 acres of land near New Castle, Pa., announcement is made of the entry of Burton Explosives, Inc., hitherto a sales organization, into the explosive and chemical manufacturing field. J. S. Burton, President and General Manager, formerly president of The Grasselli Powder Company, is quoted as stating that an initial production of 12,000,000 pounds of high explosives in 1931 is projected. A plant to employ over one hundred men is now under construction on the site of the former American High Explosives Company, of which Mr. Burton was general manager at the time of a merger of the Burton Powder Company with Grasselli in 1917. Manufacture of a line of heavy chemicals is proposed as a development to follow the establishment of the explosive line. Headquarters of the company are in the Guardian Building, Cleveland, Ohio.

A fleet of Dodge Brothers trucks, equipped with three high-voltage magnets, are constantly in operation in Louisiana, sweeping the roads for nails and stray bits of steel and iron that are such a menace to tires. The magnet road sweepers are operated every month in the year and "have saved their price several times to motorists in punctures, etc." according to Frank Grigsby, equipment superintendent.

Free Industrial Literature

You can obtain the bulletins listed on this and the following pages by using the form at the bottom of this page or by writing to the Company direct, giving the booklet number and mentioning PUBLIC WORKS.

Construction Methods and Equipment

Asphalt Heaters

8. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustsrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools and their use in road construction.

Asphalt Plants

10. J. D. Farasey Mfg. Company, Cleveland, Ohio, issue a booklet for use and specifications for Farasey Portable Asphalt Paving Plants. These R. R. 1-car plants have easy capacity of 2,250 yards, 2" surface per 8 hours. Cheap to operate.

Asphalt Rollers

12. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

Chip Spreaders

25. The Universal Road Machinery, Company of Kingston, N. Y., have issued a booklet describing their Reliance Chip Spreader, a special trailer, operating in the reverse direction, designed for resurfacing bituminous highways. Spreads to a width of 8' to any desired thickness.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully the subjects suggested by its title. A well-illustrated and instructive volume.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Published by the Solvay Sales Corp., 61 Broadway, New York, N. Y.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Building Construction, Bridges, Culverts and Concrete Products." Concise practical data, embodies latest information on subject. Issued by Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers. A 32-page booklet published by the Jaeger Machine Co., 400 Dublin Ave., Columbus, Ohio.

Crushers

56. Pioneer Gravel Equipment Manufacturing Company, Minneapolis, Minnesota, publishes complete 80-page manual, showing blue print sketches of set-ups in pit or quarry of the eleven different sizes of Pioneer Crushing Plants.

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg Co., Galion, Ohio.

59. A new booklet has just been issued by the Universal Road Machinery Company of Kingston, N. Y., describing their full line of portable and stationary crushing, screening and washing units.

Drag Lines

61. Write for complete catalog on Pioneer Drag Line. Catalog shows cross section of Drum Unit with full description of Frame, Sheaves, Motor and Bucket.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Dump Wagons, Spring Wind-Up

68. Bulletin W-30-J, just issued by Western Wheeled Scraper Company, Aurora, Illinois, illustrates and explains the new Western Automatic Spring Wind-up with which all Western Crawler dump wagons, either new or in service, can be equipped without requiring any attachment on the tractor. This device makes the employment of a wagon man unnecessary.

Dump Wagons, Steel

70. Steel Dump Bodies and hydraulic hoists for Fords and other small trucks are described and fully illustrated in technical literature published by the Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

71. "Steel Dump Bodies." Full data on steel dump bodies for every type of hauling proposition and description of special "Self-Dumper Bodies" for road Builders. Wood Hydraulic Hoist and Body Co., 7924-60 Riopelle St., Detroit, Mich.

Hoists, Truck

85. "Dump Truck Hoist." Double the Truck's value by using power operated Hydraulic Hoists. Catalog of WOOD Hydraulic Hoist and Body Company. Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Hoppers, Measuring

86. The C. S. Johnson Co., Champaign, Ill., publish a booklet which describes the Johnson Demountable Bins and Measuring Hoppers. Data sent on request.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service available from the Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Lanterns and Torches

90. Send for interesting catalog in colors of Dietz Lanterns and Road Torches adapted for night traffic warning on any construction work that obstructs the highways. R. E. Dietz Co., 60 Laight St., New York, N. Y.

Loaders and Unloaders

96. Portable car unloaders save money for the contractor on road and other construction projects. Full information on this and on the Reliance Chip and sand spreader on request. Universal Road Machinery Co., Kingston, N. Y.

97. Link-Belt Company, Philadelphia, describes a line of Portable Loaders and Unloaders in Folders: Nos. 1073 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket Elevators for different classes of work; and No. 1149, the "Grizzly" Crawler Loader for heavy work and large capacities.

Motor Trucks

107. "Trucks for Federal, State, County and City Governments," a booklet issued by Dodge Brothers, division of Chrysler Corporation, gives information about company's trucks in municipal, county, state and government activity.

Paving Materials

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. Profusely illustrated with photographs, 24 pages. The Barrett Company, 40 Rector Street, New York.

Plows

112. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

Pumps, Contractors'

119. 'Domestic' Contractors' Pumps. Automatic Priming, Ball Bearing Centifugals 2½" to 6" sizes. 'Giant' Road Pumps, 80 and 100 gallons per minute. Dependable Diaphragm and Plunger Trench Pumps and Hoists. Special Bulletins. Domestic Engine & Pump Co., Shippensburg, Pa."

122. Humdinger contractors' pumps. Diaphragm pumps in both the open discharge and the diaphragm force pump types. Self-priming Centrifugal pump, for automatic continuous prime on suction lifts up to 28'. Are described fully and valuable practical information for contractors is given in special Bulletins #107-A and 1034. Ralph B. Carter Co., 53 Park Place, New York, N. Y.

TEAR OFF AND MAIL THIS FORM FOR INDUSTRIAL LITERATURE

PUBLIC WORKS
310 East 45th Street, New York City.

.....1931
Date

Gentlemen:

Please send me without obligation the following catalogs listed under INDUSTRIAL LITERATURE SECTION:

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(Indicate by Numbers)

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Name Street Address City

2-31

Road Construction

123. "Road Construction and Maintenance" are covered in a new Cletrac Booklet, which takes up such subjects as modern methods of handling large capacity equipment, tandem equipment, etc. Cleveland Tractor Co., 1932 Euclid Ave., Cleveland, Ohio.

Road Rollers, Scrapers, Graders, etc.

125. Plows, Grade Rippers (Scarifiers) and Scrapers are fully illustrated in a new catalogue which will be sent upon request by Wiard Plow Company, Batavia, N. Y. Oldest Plow manufacturers in America.

126. Illustrated catalogs and descriptive material HERCULES All-steel, 6-cylinder road roller. 60 H.P. Gasoline engine. Sizes 5, 7, 8, 10, 12, and 15 tons. Three speeds forward and backward. Cast Steel rollers. The Hercules Company, Marion, Ohio.

127. A 16-page booklet printed in two colors gives full details and specifications of the Erie Roller. Also explains how to use it to save tamping costs. Numerous action pictures. Issued by the Erie Machine Shops, Erie, Pa.

128. A beautiful 32 page book in four colors featuring their entire line of road rollers has been published by the Buffalo-Springfield Roller Co. of Springfield, Ohio. 8¾ x 11, leatherette cover, numerous action pictures.

131. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers. The Buffalo-Springfield Roller Company, Springfield, Ohio.

132. "Road Machinery." A sixty-four page data book has been issued by the Austin-Western Road Machinery Company, 400 No. Michigan Ave., Chicago, describing their full line of road building machinery. Included in it are illustrations and descriptions of road graders, 5-foot blade to 12-foot blade; road rollers, steam or gasoline powered, 3 to 15-tons single cylinder to four cylinder. Motor graders, three sizes. Scarifiers. Crushing plant equipment, small road tools. Special bulletins on each separate piece of machinery supplement the general catalog.

133. "Road Rollers." New illustrated booklets covering the entire line of Master 4-Cylinder motor roller, 4-cylinder tandem roller and International motor roller. Galion Iron Works and Manufacturing Co., Galion, O.

134. 36-page, illustrated book describing mechanical features of Huber 4-cylinder Motor Roller and its application to many types of road construction and maintenance. Huber Mfg. Company, Marion, Ohio.

135. Road Machinery Illustrated. New illustrated bulletins on the master Motor Roller, Three-Wheel and Tandem Rollers, Motor Graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and Straight and Leaning Wheel Graders. Galion Iron Works & Mfg. Co., Galion, O.

136. Full description of Huber Motor Rollers in sizes from 5 to 15 tons, included in durable 36-page book for use by road contractors and maintenance crews. Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

Sand and Gravel Washing Plants

139. Up to date information on Portable Sand and Gravel Washing Plants with concrete capacities, ranging from 30 to 100 yards per hour.—Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Screens

140. Full information concerning Shaker and Revolving Screens, Conveyors, Elevators, Bins and Chutes is contained in catalog and special illustrated folders on Pioneer line. Write Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn.

Shovels, Cranes and Excavators

141. Link-Belt Company, Chicago, in Book 1095, gives valuable information on Heavy Duty Crawler Cranes-Shovels-Draglines, ¾ to 2½-yard capacity, with full line of attachments—grab buckets, trench hoes, dippers, magnets, hook blocks, back-filler boards, grapples, pile drivers, etc.; also complete line of Locomotive Cranes and accessories.

142. The Cranemobile, "successor to Trench Cranes," an adaptation of the crawler mounted Bay City Tractor Shovel is fully described and illustrated in Bulletin C2 just issued by Bay City Shovels, Inc., Bay City, Mich.

145. Catalog K3 just issued, completely describes the light half yard and the full half yard convertible shovel, crane, dragline, trench hoe and skimmer manufactured by Bay City Shovels, Inc., Bay City, Mich. 28 pages, over 50 illustrations, action pictures and charts.

151. The complete line of ½-yd. to 1½-yd. shovels, cranes, draglines, ditchers and skimmers manufactured by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., is described in Bulletin 60, which also gives lifting capacities and working ranges for the different sizes and types of these crawling tread machines.

Steel Forms

155. A well illustrated catalog of Steel Forms for concrete road, curb and sidewalk construction is available from The Heltzel Steel Form & Iron Company, Warren, O.

Steel Bins

159. Steel bins and measuring hoppers are included in a fully illustrated catalog of Contractors Equipment issued by The Heltzel Steel Form & Iron Company, Warren, Ohio. Write for your copy.

Steel Posts

160. Steel Posts for all purposes. Sweet's Herculean Steel Posts for highway guard rails, fences and other purposes. Catalog and data book. Sweet's Steel Company, Williamsport, Pa.

Tires, Truck and Car

165. Solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Full information and data available from Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Tractors, Crawler

169. Cletrac crawler tractors. Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, O. Bulletin 562 describes their use in roadbuilding and maintenance, earth moving, excavating, grading, snow removal, oil field work and lumbering. Made in "20," "30," and "40" and "100" sizes.

170. "Roads," a series of five fully illustrated folders, prepared by the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows what Russell graders and "Caterpillar" tractors can do and are doing to build better roads quicker and cheaper.

171. The design, construction, details and complete specifications of the new Ten and Fifteen models "Caterpillar" are given in a booklet recently published by the Caterpillar Tractor Co. of San Leandro, Calif., and Peoria, Ill.

173. Cletrac Crawler Tractors are built in a complete line by The Cleveland Tractor Company, 19322 Euclid Ave., Cleveland, Ohio. Cletracs range in size from the 12 h. p. model to the powerful 100 h. p. tractor.

Tractors, Wheel

175. "Huber Tractors" and "The Huber Motor Rollers." Illustrations of machines in operation and testimonials from users. The Huber Mfg. Co., 345 E. Center St., Marion, Ohio.

176. "Kerosene Power, the Low-Price Road Builder," book of data by the International Harvester Co., 606 So. Michigan Ave., Chicago, shows economy of kerosene tractors. Illustrations, specifications and figures on cost of operation.

Truck Cranes

182. Full-revolving, gasoline-operated Truck Cranes with a capacity of 7½ tons at a 10 ft. radius, for mounting on a 5-ton or 7½ ton auto-truck, are described in Bulletin 62, issued by the Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill.

Truck Hoists

183. "Dump Truck Hoists." Double the Truck's Value by using power operated Hydraulic Hoists. Booklet published by WOOD Hydraulic Hoist and Body Company, 7924 Riopelle St., Detroit, Michigan, describes Hydraulic Hoists for every make and model of Truck.

Road and Street Maintenance

Asphalt Heaters

201. Tar and Asphalt Kettles, Oil Burning Kettles, Pouring Pots, Torches and Hand Spraying Attachments. Full data. Connery & Company, Inc., of Philadelphia.

202. Connery & Company, Inc., 3900 N. Second St., Philadelphia, Pa., has issued a new Bulletin "J" describing the latest and improved style "J" Oil Burning Kettle for Paving Contractors, Street and Highway Departments.

203. A 54-page booklet issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates oil, wood and coal burning asphalt and tar kettles, tool heaters, sand dryers, tool boxes, traffic line markers, grout mixers, asphalt tools, etc.

Dust Control

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance. It contains tables and composition, grading, etc.

211. "Dust Control," a concise, handy pocket reference on control of dust by use of 3C Calcium Chloride. Illustrated. Issued by the Columbia Products Company, Barberton, Ohio.

Dust Laying

213. Solvay Sales Corporation, New York, supplies full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost.

Equipment

215. "Road and Street Maintenance Equipment," a compact vest pocket manual containing illustrations and brief descriptions of their extensive line, has just been issued by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Road and Paving Materials

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. A handy, useful volume, well illustrated. 47 pages, 5½x7½. The Dow Chemical Company, Midland, Mich.

Culverts, Corrugated

236. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Culverts, Large Diameter

237. The advantages of pipe culverts over open type bridges, and the latest approved practice of including detour, maintenance and operating costs in the total cost of a road or bridge project, are explained in the 16-page illustrated bulletin, "Applying Culvert Simplicity to Highway Bridge Requirements," issued by the Armco Culvert Mfrs. Association, Middletown, Ohio. Write for a copy of Bulletin H-31.

Culverts, Cost Comparisons

238. A 24-page illustrated booklet, "Selecting Culverts and Drains on the Basis of Cost per Year," reviewing the factors which, collectively considered, permit true cost comparisons between structures serving the same purpose, has been published by the Armco Culvert Mfrs. Association, Middletown, Ohio. Bulletin H-34 will be sent free on request. Write for it today.

Expansion Joint for Pavements

250. Premoulded Expansion Joints in several different types, including a new asphalt rubber joint, in order to meet various construction conditions are covered in literature issued by the Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Maintenance Materials

268. Road and street maintenance and reconstruction with BITUMULS Cold Asphaltic Binder described in an illustrated paper by C. H. Thomas, Maintenance Engineer. Reprints furnished by American Bitumuls Company, San Francisco or Baltimore.

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control. It contains tables of composition, grading, etc.

272. Preservation of Streets and Roads by the use of Road Oil, with many illustrations and testimonials from users. The Standard Oil Co. of Indiana, Chicago.

273. "Stanolind." Stanolind Paving Asphalt, a compound prepared by the Standard Oil Co. of Ind., is described in minute detail in booklet "Stanolind." Standard Oil Co. of Indiana, Chicago.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with 'Tarvia-K. P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

277. "Tarvia." An attractively illustrated 32-page booklet describing grades of Tarvia and showing photographs of actual application. The Barrett Company, 40 Rector St., New York City.

278. Information regarding crack and joint fillers furnished in gray, black, or other colors, for poured joints, also maintenance and repair work may be obtained by application to the Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Rail Filler

281. Bituminous Rail Filler used for sound deadening, rail insulation and pavement protection is described in pamphlet issued by Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Traffic, Street and Warning Signs

297. Data on "Early" street signs and sign posts. Describes adjustable method of fastening frame to staff, and illustrates porcelain enamel and other plates. Traffic and Street Sign Co., Newark, N. J.

Garbage and Refuse Disposal

305. "Pittsburgh-Des Moines Incinerator," built and guaranteed by the Pittsburgh-Des Moines Steel Company, 79 Neville Island, Pittsburgh, Pa., is described fully in a booklet sent on request.

Snow Removal

Snow Removal

349. "The Answer to the Snow Removal Problem" is the title of a new booklet just published by Carl Frink, Mfr., of Clayton, N. Y. It gives full details of the new Frink type S snow plow for trucks.

350. The W. A. Riddell Co., successors to Hadfield-Penfield Steel Co., Bucyrus, Ohio, has just issued new literature describing Fordson Snow Removers and Hadfield-Penfield One-Man Graders.

353. Efficient methods of combating quickly the snow menace on highways and city thoroughfares. Illustrates joint use of crawler tractors and standard and special snow plows. The Cleveland Tractor Co., 19322 Euclid Ave., Cleveland, Ohio.

354. "Snow Removal Equipment," a colorful booklet just off the press of the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill. Various types of snow-fighting equipment built for "Caterpillar" Tractors are pictured in relief and in action.

358. The new Type "S" Frink Sno-Plows and Frink Leveling Wings, together with complete data for selecting the proper size snow plow for your particular make and model of truck. Published by Carl H. Frink, Clayton, N. Y.

359. Calion Iron Works and Mfg. Co., Galion, Ohio, will gladly furnish details, prices and catalogs of their snow plows adaptable to any make of truck.

Sewerage and Sewage Disposal

Inlets and Manhole Covers

400. Cast iron sewer blocks, ventilators, manhole covers and inlets, valves, etc., described in pamphlet by the South Bend Foundry Co., South Bend, Ind.

Jointing Materials

401. G-K Compound for vitrified clay sewers, MINERALEAD for bell and spigot water mains, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Company, Mertztown, Pennsylvania.

Joint Materials, Sewer

403. A recent publication of the Servicised Sales Company, Monadnock Block, Chicago, Illinois, tells of the superior tightness, flexibility and durability of fibrated asphalt Sewer Pipe Belts and Joint Compounds. Complete instructions and considerable data are included in the pamphlet, now available.

Pipe, Vitrified

405. Full information regarding Vitrified Pipe and other heavy clay products. Illustrated price list on application. Factories in Pennsylvania and Ohio. The Progressive Clay Co., offices in New York City, Philadelphia, Pa., and Syracuse, N. Y.

Sewage Screens

414. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6391, which describes the construction and operation of the Dorrco Mechanically-Cleaned Bar Screen.

415. Link-Belt Company, Philadelphia, shows in Book 642 its line of sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit; and Mechanical Aerators for activated sludge plants.

Sludge Bed Glass Covers

418. Sludge Bed Glass Covers—"Super-Frame" Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, Describing glass covers for sludge and sprinkler beds.

Sludge Bed Glass-Overs

421. The use of Lord & Burnham sludge bed Glass-Overs at Dayton, Ohio, are described in Subject No. 10. There are 11 Glass-Overs, each 60 feet wide and 163 feet long, covering 2½ acres. Lord & Burnham Co., Graybar Bldg., New York.

422. The use of Lord & Burnham sludge bed Glass-Overs at the Highland Park, Ill., sewage treatment plant are described in Subject No. 11. This is one of the smaller of the eight sewage treatment plants on the Chicago North Shore. Lord & Burnham, Graybar Bldg., New York.

423. Sludge Glass-Overs at Fostoria, Ohio, are described in Subject No. 14. At this plant the sludge removal carrier is supported directly on the roof construction. Lord & Burnham Co., Graybar Bldg., New York.

424. The Sludge Glass Overs at the Bloomington and Normal, Ill., plant are described in Subject No. 15. The plant serves a population of 54,000. A sludge bed area of 0.774 square feet for maximum estimated population is provided. Lord and Burnham Co., Graybar Bldg., New York.

Treatment

425. Dorr Company, 247 Park Ave., New York, in its Sanitary Engineering bulletin describes the use of its equipment for treating municipal sewage, industrial wastes and water. Photos of numerous operating plants are shown as well as representative flow sheets illustrating the various methods of sewage treatment.

427. The Pacific Flush Tank Company, of Chicago and New York, publish eight separate catalogs on Sewer and Sewage Disposal Automatic Equipment, including pumps, Imhoff Tanks and Sewer Joint Compounds. These are of real value to the designer or operator of a treatment plant.

428. Advantages of Liquid Chlorine for disinfection given in booklet issued by the Electro Bleaching Gas Co., 9 East 41st St., New York.

429. Chlorine is being extensively used in the disinfection of sewage not only as a disfectant but as an aid to other purification processes. Wallace & Tiernan Co., Inc., Newark, N. J., have a publication, No. 42, on the chlorination of sewage, which will be sent to any address on request.

430. The Dorr Co., 247 Park Ave., N. Y., publishes Bulletin No. 6171, which describes the treatment of sewage with Dorr Traction Clarifier, an improved type of continuous sedimentation for use in water and sewage treatment plants.

432. The Dorr Company, 247 Park Ave., N. Y. C., publishes Bulletin No. 6481, which describes the construction and operation of the Dorr Detritor for continuously removing and washing the grit from sewage flows.

434. Automatic, continuous vacuum filters, producing a relatively dry cake of sludge in demand for fertilizer, are used by: Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C., write for literature. Oliver United Filters, Inc., Federal Reserve Bank Bldg., San Francisco, Calif.

Water Works Equipment

Aeration and Diffusion Plates

465. A complete booklet describes Norton Porous plates for activated sludge treatment plants, and for other sewage and water uses; also other shapes of fused alumina. Booklet includes data regarding chemical and physical characteristics, and tables published by Norton Co., Worcester, Mass.

Couplings and Tees

485. Copper pipe for water works services and patented connections for jointing to corporation stops, iron pipe, etc. Full data 22 pages 8½ x 11. The Mueller Co., Decatur, Ill.

505. "Mathews" Fire Hydrants. Gate Valves and other water works appurtenances. 16 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

506. Hydrants, tapping apparatus, gate locks, valves and curb cocks described in a series of bulletins issued by A. P. Smith Mfg. Co., East Orange, N. J.

Jointing Materials

515. MINERALEAD for bell and spigot water mains, G-K Compound for vitrified clay sewers, also M-D Cut-Ins for making house connections, described in catalogue of Atlas Mineral Products Co., Mertztown, Pa.

Meter Boxes

525. Efficient installation and mainte-

For latest catalogs—consult the *classified* INDUSTRIAL LITERATURE section, beginning on page 85

nance of water meters is described in catalog issued by H. W. Clark Company, Mattoon, Ill., manufacturers of Meter Boxes, Coupling Yokes, Meter Testers, Service and Valve Boxes.

526. An illustrated catalog covering meter boxes and specialties such as gate valve housing, curb boxes, meter testers, melting furnaces, jointing materials, four-in-one pumps, has recently been published by the Hydraulic Equipment Co., Reading, Pa.

Pipe, Cast Iron

534. "Sand-Spun," Centrifugal cast iron pipe manufactured by R. D. Wood & Co., Philadelphia, is fully described in a valuable 16-page 6x9 booklet, containing also complete specifications of this pipe. No engineer or water works official should be without this booklet.

535. Cast Iron Pipe and Fittings, sizes 1¼ through 12 inches, either with or without Precaulked lead joints factory-made in the bells. Data book sent free. The McWane Cast Iron Pipe Co., Birmingham, Ala, and Provo, Utah.

536. "Weights and dimensions of Cast Iron Pipe and Fittings." A handy reference book for Municipalities and Contractors. 48 pages, 7¾x10¾. R. D. Wood & Co., Philadelphia.

537. "Uinversal Cast Iron Pipe," for water supply, fire protection and sewage disposal. All jointing materials eliminated. Machined iron-to-iron joints made with wrenches only. (Booklet). The Central Foundry Company, 420 Lexington Ave., New York, N. Y.

538. "High Pressure Fire Protection Lines." Booklet containing excerpts from Underwriters report on Universal Cast Iron Pipe. The Central Foundry Company, 420 Lexington Ave., New York, N. Y.

539. U. S. Cast Iron Pipe Handbook contains useful tables and data for the Water Works man on pipe line construction. Issued by U. S. Cast Iron Pipe and Foundry Company, Burlington, N. J.

Pipe, Cement Lined

540. Steel or Wrought Iron Pipe lined with cement and special lead-lined joints, manufactured by the Cement Lined Pipe Co., of Lynn, Mass.

Pipe for Subdrainage

549. A revised 16-page well illustrated bulletin, "Increasing the Efficiency of Roadbed Drainage," containing information on the newest developments in the application of subdrainage to highway, municipal and public works construction —including frost boil prevention, landslide control and airport drainage. Ask for Bulletin H-30. Armco Culvert Mfrs. Association, Middletown, Ohio.

Pump Packing

575. "When Power Is Down," by the Sterling Engine Company, Buffalo, N. Y., gives recommendations of models for standby services for all power requirements.

Service Boxes

578. "Service Boxes with Stay-on Covers. No more broken covers. No more lost covers." (Booklet). The Central Foundry Company, 120 Lexington Avenue, New York, N. Y.

Storm Sewers

579. A valuable 24-page, 6x9 illustrated bulletin for city engineers and officials, entitled "Planning Municipal Drainage for Today and Tomorrow," has been published by Armco Culvert Mfrs. Association, Middletown, Ohio. Sent to anyone interested free on request.

Swimming Pools

580. Wallace & Tiernan Co., Inc., Newark, N. J., have just published a new edition of technical publication, No. 41, dealing with the sterilization of swimming pools by liquid chlorine. Copy sent on request.

Tanks and Stand Pipes

582. A 50-page booklet issued by Pittsburgh Des Moines Steel Co., 79 Neville Island, Pittsburgh, Pa., on complete water works plants, elevated tanks, stand pipes and filtration plants built by them.

Tapping and Valve Machines

583. The A. P. Smith Company, of East Orange, N. J., furnish descriptive matter dealing with their many labor saving devices as the Smith tapping machine, valve inserting machine and pipe cutting machines.

Miscellaneous

Airport Construction

597. "Getting on the Air Map With 'Caterpillar'," profusely illustrated with action pictures, describes the many uses of the tractor in building and maintaining airports better, quicker, cheaper. Caterpillar Traction Co., San Leandro, Calif., and Peoria, Ill.

Airport Drainage

598. "Building Safety Into Airports—with Efficient Drainage Construction," a 24-page well illustrated booklet outlining the requirements for airport drainage has been published by the Armco Culvert Mfrs. Association, Middletown, Ohio. A copy will be sent to those interested free on request. Ask for Bulletin C-2.

599. The added advantage in using Toncan Iron Culverts under highways for airport drainage, storm sewers, suburban allotments, etc., because of Toncan's alloy composition, is described in bulletin—"We are living in the Alloy age"—Toncan Culvert Mfrs. Association, Massillon, Ohio.

Asphalt Bridge Planking

600. A new and improved asphalt composition has been developed as a long wearing and resilient paving material for bridges, viaducts, railroad platforms, etc., covered by Catalog No. 12, now available from Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Asphalt Construction

605. Methods of mixing BITUMULS Cold Asphaltic Cement with natural soil or gravel for inexpensive landing areas and of constructing BITUMULS (cold) penetrated runways described in construction reports furnished by the American Bitumuls Company, 503 Market Street, San Francisco.

Community Advertising

610. Booklet showing various forms of publicity matter useful in arousing interest in the construction of small town water supplies. This matter is furnished free to Consulting Engineers and towns interested in waterworks construction by The Cast Iron Pipe Research Association, 566 Peoples Gas Bldg., Chicago, Ill.

Highway Crossings

612. A most serviceable and durable railroad crossing for city streets and main highways, is composed of fibrated asphalt planking and rail filler sections. Complete description and data will be furnished by Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Industrial Flooring

615. An extremely serviceable Fibrated recent contributions to industrial efficiency. *Duo-Type Flooring*—interlocking Asphalt Industrial Flooring is one of the sections with asphalt plank base and rubber block wearing surface offers a splendid combination of these products. Ask for pamphlets from Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

Rules

625. The Lufkin Rule Company, Saginaw, Mich.; New York; Windsor, Canada. Manufacturers of Measuring Tapes, Boxwood Rules, Spring Joint Rules, Straight and Folding Steel Rules, Fine Mechanics Tools and Aluminum Folding Rules. General Catalog No. 11.

Tree Moving

632. "Tree Moving," folder from the Caterpillar Tractor Co., of San Leandro, Calif., and Peoria, Ill., shows and tells with action pictures and the letters of landscaping experts how to successfully move large trees.

Waterproofing Protection Course

640. Fibrated Asphalt Waterproofing Protection Course planks as now used for protection course to membrane waterproofing on railroad structures, viaducts, large roofs, etc., is described in Catalog No. 12, issued by Servicised Premoulded Products, Inc., 53 W. Jackson Blvd., Chicago, Ill.

New Catalogs

Not described before in the Industrial Literature Section.

110. "Tarmac Cold Mix." Complete data and pictures on plant-mixed pavements laid cold. American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

Power Graders

117. A large wall display piece, No. 3101, printed in three colors and containing a very large illustration of the WARCO Model "E" power grader as well as complete description and working views on center control graders will be sent by the W. A. Riddell Co., of Bucyrus, Ohio, to anyone interested.

Wheeled Scoops

190. The WARCO wheeled scoops, claimed to offer the most economical handling of earth on short hauls, is fully described and illustrated in Bulletin No. 3102 issued by the W. A. Riddell Co., of Bucyrus, Ohio. Printed in three colors and fully illustrated—will be sent to anyone interested.

Maintenance Materials

267. "Mixed-in-Place Construction with Tarmac." Step-by-step pictures and specifications for constructing road surfaces by Retread or Turnover methods American Tar Products Co., Koppers Bldg., Pittsburgh, Pa.

Jointing Materials

402. An illustrated folder has just been issued by the Cochrane Chemical Co., 432 Danforth St., Jersey City, N. J., detailing the advantages and the savings in the use of Ex-XL-cell Sewer Pipe Joint Compound.

Waterproofing and Dampproofing

635. Headley Emulsified Products Co., Philadelphia, has issued Bulletin 330, which gives some very valuable information regarding dampproofing, insulating, and waterproofing methods and materials for floors, walls, roofs, tanks, swimming pools, etc.

Index to Advertisements

When you want catalogs describing materials or equipment advertised in PUBLIC WORKS, refer to the *classified* INDUSTRIAL LITERATURE section beginning on page 85 and order by number.

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